TEN MONTHS' PROSPERITY IN THE PITTSBURG DISTRICT

With Tremendous Production, Extensive Improvements and Additions, Heavy Business and Fair Prices—Then Came the Slump—The Story of a Remarkable Year

By W. B. Robinson.

It is at this time of the year, the business man stands at the fork of the roads. Behind him are his works of the past 12 months, and ahead the prospects and possibilities of the future. The road ahead is obscured to a great extent by the haze of the financial difficulties through which the country is now passing, but in looking behind the roadway is dotted with monuments of great achievements commemorating events which may be looked back upon with satisfaction and pride. A review of the past 12 months from a business standpoint, will, in practically every line, show a good, big full year, which carries with it extensive business, heavy production, fair profits, and, during at least the first 10 months, manufacuring establishments running to full capacity and straining a point to over-reach it. There have been a few high spots as far as prices are concerned, but as a general proposition the year shows a record of prices fair to both the buyer and the seller. There has been some variation in the prices of crude and semi-finished materials, but neither the high nor low records of previous years were touched. In finished lines, the prices throughout the year were generally maintained on an even and equitable basis, and there was little cause for complaint from anyone. It is true that during periods of extreme congestion, when mills were unable to make deliveries within anything like ordinary periods, opportunists took advantage and exacted premiums. but this was the exception rather than the rule.

The year will go down into history as exceedingly prosperous and one of the best on record in tonnages, new business and average prices. It will go on record as a year of immense expenditures for betterments and improvements, and close after all its successes and high pressure from an operating standpoint, with plants and equipment in the highest possible condition of efficiency. While as a whole it has been exceedingly prosperous, the year has been unusual, in that a very high percentage of earnings has been put back into the business on extensions and improvements. The depression during the last three months of the year came at a time when it held off temporarily a large number of contemplated improvements, work on which will be resumed with the coming of better financial conditions, but it also came at a time when a large part of the new work was so far along that it was carried to completion notwithstanding the stringency, although the presssure upon working forces to rush the work was greatly relieved.

The Change in Conditions.

The crash which hit the iron and steel business and the country generally during the latter part of the year may rightfully be dated from Oct. 24, upon which day the Knickerbocker Trust Co. of New York closed its doors, this instance being the first of a series of important financial difficulties which were felt from one end of the country to the other. While it has been stated that the extreme depression came with such suddenness as to be compared to a bolt from a clear sky, this simile is only comparative, as its approach had been noticed in some lines of business as early as the first part of September. It was about this time that a decrease in business began to show up on the order books of manufacturing companies, and that shipments began to exceed the volume of new business for the first time during the year, and this condition continued until the close. October was one of the best operating months of the year, and several production records were broken, but it was largely because of the effort made by manufacturers to clean up business not already under suspension before the full force of the crisis reached them. Several causes have contributed to the sudden depression, but the most plausible is that there has been too great an extension of credit; in other words, the country had been doing more business than there was money to finance. Business will have to adjust itself to a contracted banking capacity. The railroads consume practically 50 per cent of the iron and steel

AVERAGE MONTHLY PRICES OF IRON AND STEEL AT PITTSBURG, 1907.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Bessemer Pig Iron	$22.92	$22.78	$22.85	$22.15	$24.08	$24.10	$23.31	$22.90	$22.90	$22.75	$20.65	$19.90
No. 2 Foundry	24.15	24.85	24.85	24.85	25.35	25.35	24.00	23.40	22.15	20.90	20.00	17.90
Gray Forge	22.50	22.35	21.35	21.50	22.45	23.50	23.00	22.40	21.15	19.90	19.40	17.40
Ferro-Manganese	78.00	76.00	76.00	73.50	69.50	65.25	63.00	61.75	59.00	54.50	53.00	51.00
Bessemer Billets	29.75	29.50	29.25	29.75	30.25	31.00	30.00	30.00	29.50	28.50	28.00	28.00
Rails (Standards)	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00
Rails (Light, 20 lb)	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	31.00	31.00
Beams and Channels (15" and under)	1.70c	1.70c	1.70	1.70	1.70c	1.70c	1.70c	1.70c	1.70c	1.70c	1.70c	1.70c
Tank Plate	1.70	1.70	1.70	1.70	1.80	1.80	1.80	1.70	1.70	1.70	1.70	1.70
Steel Bars	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60
Bar Iron	1.80	1.80	1.80	1.80	1.75	1.75	1.75	1.75	1.70	1.70	1.60	1.60
Sheets, (28 black)	$2.60	$2.60	$2.60	$2.60	$2.60	$2.60	$2.60	$2.60	$2.60	$2.60	$2.60	$2.60
Sheets (28 Galvanized)	3.65	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
Sheets (blue annealed 10 and heavier)	1.80	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85
Tin Plate	3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90
Wire Nails	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.05	2.05	2.05	2.05
Foundry Coke	3.95	3.80	3.60	3.40	3.10	3.00	3.10	3.20	3.25	3.25	2.90	2.70
Furnace Coke	3.75	3.55	3.00	2.70	2.15	2.05	2.40	2.60	2.80	2.90	2.40	2.00
Heavy Melting Scrap	18.70	18.50	18.00	18.00	18.00	18.50	18.00	18.75	18.50	17.00	15.00	13.50

used in the country, and to the fact that they have not been buyers to anywhere near the usual extent during the last half of the year just closed is attributed a large part of the difficulty. It is a well known fact that many of the big trunk lines have had a very heavy volume of short time notes, and if a plan can be devised whereby the railroads can induce holders of these short time notes to take other securities, either stocks or bonds, or accept extensions, it will relieve present necessities and enable the roads to take care of needed improvements. The needs of railroads and municipalities are going to be greater during the next few years than ever before. The growth of cities is constantly bringing up problems of transportation, sewerage and building construction that will bring out larger expenditures and consequent increased use of steel, as steel will naturally become a greater factor in these improvements from year to year. In New York City alone, there is at the present time, $122,000,000 in contemplated improvements now held up on account of financial conditions. It is believed, however, that the ingenuity and progress of the age will solve this problem, and permit the carrying out not only of those improvements already mapped out, but others of equal magnitude in contemplation.

The tremendous curtailment in production, it is believed, will equalize the demands of business to a proper ratio of credit.

Large manufacturers do not predict any immediate resumption of business on a large scale, but there is reason for believing that there willl be a gradual improvement between this time and the latter part of 1908, and that, after the political situation has cleared away, everything will be again running to full capacity.

Heavy Pig Iron Production.

The past year established a new high mark for pig iron production, and when figures are all in, will show practically 25,750,000 tons of pig iron made during the year. This is an increase of about half a million tons over 1906, or in actual figures 25,750,000 tons for 1907 as against 25,300,000 in 1906. Even with these figures, the production is at least 1,000,000 tons below expectations, inasmuch as the slump during the last three months of the year caused a curtailment of at least 1,000,000 tons. Pittsburg and Allegheny counties, which, during 1906, with their 42 blast furnaces made 5,702,722 tons of pig iron, or 22½ per cent of the country's total output, maintained their pace in the race. The 42 old furnaces ran to better advantage in 1907 than during the previous year, and there was added the output of three new stacks, two at the Carrie plant of the Carnegie Steel Co. and one at the Monongahela plant of the National Tube Co. From a buying standpoint, the pig iron situation during the year was peculiar, inasmuch as all of the large buying was done during the first half of the year. The largest single sale was during April, when the Youngstown Sheet & Tube Co., Youngstown, O., bought 160,000 tons of Bessemer iron on the basis of $21 at the valley furnaces, and the total sales for the month reached 230,000 tons. During March, the reported sales were 65,800 tons, and during the next three months running through July from 30,000 to 50,000 tons per month. The average monthly price of Bessemer iron based on the sales of 1,000 tons or over was highest in May, and from that time gradually decreased until the end of the year. These average monthly prices, which are taken as a basis and settlement price on a number of adjustment contracts for pig iron and for scale contracts for billets and some finished products, were as follows:

	Valley.	Pittsburg.
January	$22.07	$22.92
February	21.93	22.78
March	22.05	22.90
April	21.36	22.21
May	23.28	24.13
June	23.25	24.15
July	22.41	23.31
August	22.00	22.90
September	22.00	22.90
October	21.89	22.79
November	19.75	20.65
December	19.00	19.90

Additions to Steel Plant.

The Pittsburg district has, during the past year, seen some very large increases under way in the direction of new construction of steel capacity. The Carnegie Steel Co. is adding 18 50-ton open-hearth furnaces at its Duquesne plant, with an estimated capacity of 800,000 gross tons of steel ingots per year. The Jones & Laughlin Steel Co. is completing four additional Talbot continuous open-hearth furnaces at the South Side Works, these to have a capacity of 1,000 tons of steel ingots per day. The six Talbots at the new Aliquippa plant of the Jones & Laughlin Steel Co. are not being pushed, as work on these, as well as the four blast furnaces at the new works, has been temporarily abandoned. One of the biggest events of the year affecting semi-finished steel production was made public about July 1, when the Pittsburg Steel Co. formally announced its plans, inviting subscriptions to a $4,000,000 bond issue, of which $3,000,000 was to be used in the erection of eight 60-ton open-hearth steel furnaces, a blooming mill and three billet mills, to supply its wire plant at Monessen, its hoop mill at Glassport, and its allied interest, the Seamless Tube Co. of America. This construction work is now well under way. Since June 27, 1905, the Pittsburg Steel Co.'s billet supply was bought from the Carnegie Steel Co. on a five-year contract calling for 200,000 tons per year. Notice of the termination of this contract July 1, 1908, has been given. During the year the Allegheny Steel Co. completed its fourth 50-ton open-hearth furnace. The average monthly market prices of Bessemer steel rolling billets has varied considerably, ranging beween $29 and $30 during the first five months of the year, $31 in June, $30 during July and August, and then gradually shading down to $28 during the last two months of the year. That there was no shading of this $28 price on the very dull market is due entirely to the fact that producers of steel at a meeting in Pittsburg established a community of interests and agreed to hold this price. Sheet bars, on which most of the heavy buying was done during the first part of the year, averaged $31 mill during the third and fourth quarters, and it was not until just prior to the Christmas holidays that the leading interest announced a reduction of $2 per ton, or $29 Pittsburg, on business placed for the first quarter of 1908.

The Rail Situation.

The rail shipments from mills during the year exclusive of the Tennessee Coal, Iron & Railroad Co. and the Colorado Fuel & Iron Co., during the first 11 months of the year were 2,165,722 net tons. The Bethlehem Steel Co. is not included, inasmuch as it did not become a factor until very late in the year. The rail market at the end of the year presented a very peculiar situation, inasmuch as the Carnegie Steel Co. which may be taken as a fair representative, with a yearly capacity of 1,000,000 tons, will carry over into 1908 at least 500,000 tons because of suspensions and lack of specifications against existing contracts. A majority of this held-over tonnage will not be specified until a definite agree-

ment is reached between manufacturers and railroads as to standard section and specifications. The much mooted question of superiority of open hearth over Bessemer rails came up for much discussion, but will have very little bearing on the coming year, inasmuch as steel makers have not got capacity to make open hearth rails if they were ordered, and manufacturers of Bessemer rails in the United States and Canada have agreed upon a standard specification to govern their product during 1908, the price to be controlled by the percentage of discard from the ingot, based on $28 mill for a nine per cent discard and an increase of 29 cents per ton for each additional one per cent discard. The price of light rails, 20 pound section, remained at $34 from January to November, and during the last two months was reduced $3 per ton to meet the price of re-rollers.

Structural Shapes.

The estimated total production of the United States during 1907 is 1,700,000 tons of structural shapes, of which the United States Steel Corporation tonnage is estimated at 1,000,000 tons. The 1907 production was not within 200,000 tons of the previous year, the decrease being attributed to the wonderful strides made in re-inforced concrete construction, although it is figured that during 1905 the inroads made by re-inforced concrete construction were greater, taken as a whole, than during the year under review. The year has seen no change in the official price of structural material, the basis being 1.70c Pittsburg throughout that period. Among the features worthy of notice in the trade during the past year, have been the new uses found for structural shapes and plates, chief among these being the development of steel sheet piling and mine timbering. The increased capacity for the manufacture of structural shapes during the year is limited to the Bethlehem Steel Co., but this new mill was not in full operation at the end of the year. The 28-inch mill at Chicago began operations during the latter part of 1906.

Plates Rather Dull.

The estimated plate production for 1907 is 2,225,000 net tons, of which it is estimated the Steel Corporation manufactured 1,300,000 tons. It may be notel that about one-half of the plate production of the year under review was carried over from the previous year. The tonnage that will be carried over into 1908 is exceedingly large, but on account of suspensions is of so indefinite a nature that any estimate would be nothing more than surmise. The business is on the books of manufacturing companies, but will not be taken out until there is a very decided revival in the financial situation and the stringency of the past two months removed. Taken as a whole, the 1907 plate and shape business has been comparatively dull, although production figures as comparisons show up very well. The apparent inconsistency of the dull business and heavy production, is explained by the fact that there have been no very large sales made during the year. This may be applied in part to the steel car manufacturers, who, while they have been busy to the limit throughout the year, have not placed steel tonnage with the mills during the year in proportion to their own activities. This leads back to 1906, during the latter part of which year nearly all the large car orders by transportation companies were placed, this business going to the credit of 1905, although in reality it was carried through 1907.

Merchant Pipe and Boiler Tubes.

The year from the standpoint of manufacturers of merchant pipe and boiler tubes, taken as a whole shows several unusual features. In the first place the tonnage of the leading interest, not figuring on any of its smaller constituent companies, will be 1,100,000 tons, or an increase of about 10 per cent over the previous year. This tonnage will, figuring on the average yearly increase, show only about an average year, with this difference, however, that practically all the business was done within the first ten months. The year was heavy, from the standpoint of both shipments and new business and on account of the crowded condition of the mills and inability to make shipments, there was a period of two months when all quotations were practically withdrawn and no delivery promises whatever made to purchasers. Among some of the larger contracts placed during the year was an 8-inch line 60 miles long across the Isthmus of Panama for the Union Oil Co., an 8-inch line 435 miles long from Indian Territory to the Gulf of Mexico for the Gulf Refining Co.; an 8-inch line 250 miles long for the Southern Pacific Railroad; a 10-inch line 265 miles long for the Burmah Oil Co. of India. The year has seen no new construction as far as new competitive plants are concerned, but during the past 12 months eight of the 18 welding furnaces at McKeesport, Pa., which will be the largest pipe plant in the world, were started. The leading interest also built one new blast furnace at McKeesport and one at Lorain. The year has also seen the perfection of boiler tubes known as the Spellerized tube for both locomotive and stationary boiler use, tests of this tube showing it superior to the old charcoal iron tube.

Sheets and Tin Plate.

The year from the standpoint of sheet and tin plate manufacturers has been immensely satisfactory. It is true that on account of the high price of semi-finished material, tin and spelter, during several months the margin of profit has been comparatively small for those manufacturers who have depended upon the open market for their supply, but on the other hand the volume of business has been heavy, and taken as a whole there has been no cause for serious complaint. From the standpoint of production the year has been a record breaker, and the average percentage of mills, both sheet and tin plate, in operation has been larger than for several years past. So heavy was the demand during the spring and summer, that delivery promises were as much as four to five months from date of order. There have been several new sheet plants started and one or two abandoned. The largest new additions to the productive capacity have been additions to the Vandergrift plant of the leading interest a new 8-mill plant has been installed by the LaBelle Iron Works at Steubenville and the Seneca Iron & Steel Co. near Buffalo began operations. The Niles, O., plant and the Star plant, Pittsburg, of the leading interest were abandoned during the year, but additions to other plants more than made up for this loss of manufacturing capacity. It may truthfully be said that the physical condition of sheet and tin plate plants throughout the country, is better than it has been for several years past, not so much because of new capacity but because of betterments and improvements in the way of modern practice which have been installed, more money having been expended in this direction during the past calendar year than has been the case for several years past. Prices, with the exception of a little shading at the beginning of the depression in October and November, have been uniform throughout the year, and the close of the year found the market

firm but quiet, this condition being maintained at the cost of production.

Labor Conditions.

The labor situation throughout the year has not been unruffled, although aside from the strike of machinists in the Pittsburg district, there has been no labor trouble that resulted seriously. Early in the year the machinists made a demand for an increased minimum wage, which was sturdily resisted all along the line, and with one or two exceptions continued in force throughout the year and in the majority of shops is still unsettled and hanging fire. For the first time in several years it was found necessary, after the June convention had agreed upon its scales, for the manufacturers and the association to agree, and the matter was referred to a conciliation board which finally decided as equitable the new basis of sliding scale based upon iron bars bars moving by twentieths of a cent, starting with boiling at $5 on one cent bar iron and moving by 12½ cents for each 1/20 cent to $7.50 on two cent bar iron instead of the old scale base in which iron bars moved by tenths of a cent with boiling at $5 for 1.2-cent bar iron, and 25 cents higher for each tenth cent to $7 for 2-cent bar iron. The year saw more advances through sliding wage scales, than for several years. Aside from the change of scales noted in bar iron, the tin plate workers secured three successive advances, putting the wages at six per cent above the base, a rate which is still maintained. The sheet workers got two advances of 2.6 per cent each, one of which has come off. The first sheet workers' advance came with the settlement of May 10, when it was shown that the average realized price was between $2.40 and $2.50, and put wages for May and June 2.6 per cent above the base. The September settlement added another 2.6 per cent, but during November the latter was removed and sheet wages remained, to the end of the year, at 2.6 per cent above the base. Of its own volition, the American Sheet & Tin Plate Co. extended these advances to its non-union sheet and tin plate mills, although the sliding scale agreement covers only those sheet and tin plate mills controlled by the Amalgamated Association. The iron wage settlements for the year were as follows:

Iron Wage Settlements.

Shipments during—	Iron Bars, cents.	Boiling, per ton.
November-December	1.5	$5.75
January-February	1.5	5.75
March-April	1.6	6.00
May-June	1.65	6.62½
July-August	1.65	6.62½
September-October	1.60	6.50

During June, when pig iron production was at the maximum point, the furnace workers in the Mahoning and Shenango valleys threatened to strike for increased wages and shorter hours, and for a time serious trouble was anticipated. Furnace owners, however, took a very decided stand, and because of dissention in the union ranks all trouble was avoided.

Coke Production.

The unofficial figures of the coke production in the Connellsville and Lower Connelsville regions for 1907 will show a surprise for those who expected a bumper output from the regions. The official figures, as compiled by the *Connellsville Courier* at the end of 1906 showed the output to be 19,999,326 tons. A compilation of the estimated weekly productions through 1907, exclusive of the last week and three days, shows the total to be 19,609,154 tons, or with an estimate of 150,000 tons for this period, which will be pretty close, a falling off during the past year, as compared with the previous year, of approximately a quarter of million tons. The total production during 1905 was 17,896,526 tons. The total number of ovens recorded in the regions at the end of 1907 was 34,059, and on Dec. 21, 1907, the figures showed 35,617, an increase of only 1,558 ovens, despite

Production of Coke.

The Connellsville coke region—Ovens in and out of blast; estimated weekly production. (Compiled from *The Connellsville Courier.*)

Week ending—	Ovens.	In blast.	Out of blast.	Estimated production. (tons)
Jan. 5	33,549	31,837	1,712	410,934
Jan. 12	33,698	32,007	1 691	412,000
Jan. 19	33,698	32,010	1,688	412,565
Jan. 26	33,708	31,839	1,869	412,694
Feb. 2	33,742	31,789	1,951	410,706
Feb. 9	33 809	31,871	1,938	409,676
Feb. 16	33,828	31,876	1,952	409,903
Feb. 23	33,869	32,046	1,823	411,544
March 2	33,859	32,080	1,779	411,257
March 9	34,018	32,241	1,777	413,572
March 16	34,054	32,374	1,680	415,123
March 23	34 131	32,425	1,706	388,950*
March 30	34,209	31,242	2,967	404,478*
April 6	34,288	32,409	1,879	416,770
April 13	34,289	32,210	2,079	415,300
April 20	34,325	32,193	2,132	416,583
April 27	34,426	32,512	1,914	416,217
May 4	34,470	32,415	2,055	415,482
May 11	34,460	32,365	2,095	416,971
May 18	34 460	32,367	2,093	420,732
May 25	34,518	32,413	2,105	421,278
June 1	34,648	32,466	2,182	406,422†
June 8	34,648	32,441	2,207	420,467
June 15	34 694	32,443	2,251	421,157
June 22	34,698	32,527	2,171	419,574
June 29	34,928	32,411	2,517	412,016
July 6	34,928	32,544	2,384	313,820‡
July 13	34,958	32,445	2,513	395,998
July 20	35,039	32,565	2,474	405,107
July 27	35,039	32,565	2,474	404,997
Aug. 3	34,920	32,479	2,441	419,025
Aug. 10	35,165	32,748	2,417	407,735
Aug. 17	35,253	32,755	2,498	420,146
Aug. 24	35,299	32,919	2,380	420,883
Aug. 31	35,399	33,136	2,263	425,411
Sept. 7	35 399	33,136	2,263	425,952
Sept. 14	35,399	33,136	2,263	425,423
Sept. 21	34,850	33,195	1,655	427,969
Sept. 28	34,850	33,195	1,655	429,127
Oct. 5	34,852	33,190	1,662	426,850
Oct. 12	34 852	33,226	1,626	429,038
Oct. 19	34,880	33,254	1,626	426,598
Oct. 26	35,096	33,151	1,945	418,385
Nov. 2	35,108	30,931	4,177	352,611
Nov. 9	35,214	30,888	4,326	322,340
Nov. 16	35.396	25,563	9,833	263,628
Nov. 23	35,454	23,724	11,730	207,154
Nov. 30	35,454	22,465	12,989	210,323
Dec. 7	35,402	21,048	14.474	202,472
Dec. 14	35,547	14,973	20,574	135,252
Dec. 21	35,617	14,548	21,069	150,538
				19,609,154

* Account flood. † One holiday. ‡ Holiday week.

the large number of plants built and put in operation during the year. The solution is that about 4,000 ovens were abandoned. The average prices for the year on spot coke, as computed from our weekly reports were as follows:

	Foundry Coke.	Furnace Coke.
January	$3.95	$3.75
February	3.80	3.55
March	3.60	3.00
April	3.40	2.70
May	3.10	2.15
June	3.00	2.05
July	3.10	2.40
August	3.20	2.60
September	3.25	2.80
October	3.25	2.90
November	2.90	2.40
December	2.70	1.90

PITTSBURG.

Exaggerated Reports of Resumption—Tin Plate Makers Confer.

Office of THE IRON TRADE REVIEW,
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What there is to the market where any market is visible is more in the nature of anticipation for the future, rather than actual present transactions. Of actual transactions there are very few. Pig iron is extremely quiet, and the only inquiries reported in the market were those for about 500 tons of Bessemer iron and approximately 1,300 tons of basic iron. The large independent producers of Bessemer iron in position to quote at all, that is those whose furnaces are in blast, are asking $19 valley for January iron, but this is being shaded by smaller independent furnaces that are operating on going contracts, and endeavoring to get additional business in order to prolong operations.

The extended reports in the daily press regarding resumptions of manufacturing establishments in all parts of the country are largely overdrawn, and have a tendency to create an impression which, when the actual facts become known, will be more detrimental than beneficial. Many plants are reported as resuming operations or getting ready to resume, immediately after the first of the year, when as a matter of fact they have been running, but on reduced time, with the exception of the customary annual holiday shut down. As has been noted in these reports, a large part of the resumption of mill operation has been intermittent, mills starting to run off a little current business and then shutting down again, and in none of these instances has there been enough business ahead to warrant any prediction of continued operations. The only steel mill of the corporation that has resumed operations with any definite assurance of continuing, was the New Castle plant which started on Sunday night of this week in order to furnish tin bars for several plants of the American Sheet & Tin Plate Co. which will be put on after the first of the year to take care of first quarter business. While nothing definite has as yet been decided, and no announcement will be made until the latter part of the week, it is probable that a part or whole of the tin mill plants at New Kensington, Monessen, Martin's Ferry and Shenango will go on about Jan. 6, a total of about 47 tin mills in addition to approximately 50 that have been running all the time. McKeesport Tin Plate Co. has been down for two weeks, Pope Tin Plate Co. is down and Follansbee Bros. is down and no definite idea can be given as to when they will resume. The National Tube Co. which shut down its McKeesport plant Christmas eve, will put on about one-half capacity either Jan. 6 or surely Jan. 13. This resumption will put in two blast furnaces and their output will be used in the mills, the welding furnaces to resume depending upon the sizes of pipe most needed. The Pennsylvania department of the National Tube Co. has been running continuously, but all others are down. Repairs at Lorain cannot be completed before Jan. 20 and the volume of business only will determine when the plant will be put in operation. It is reported that the steel car companies are getting close to the end of their order books; that one of the large companies has only enough business to carry it through January and the other only a month or six weeks beyond that time, and a shut down on the part of both will be imperative unless the railroads place new business, which at this time is unlikely. The Republic Iron & Steel Co. has planned to start the steel plant, Brown-Bonnell plant and Valley plant, at Youngstown, Jan. 6, but there is no assurance as to the length of time they will operate.

The past week has seen a series of conferences among the independent tin plate manufacturers, in which the leading interest has participated. The plan as outlined at these conferences has been to devise means of maintaining present prices throughout the first quarter of 1908. To date there has been no shading. The sheet market in the face of very light business is firmer than it has been for two months, this being accomplished at the expense of production. In view of the fact that there has been no change in market prices at any point, we will this week omit our usual schedule of prices with the statement that they are nominally unchanged.

The firm of Parker & Lee, heretofore engaged in the work of publicity, with offices in New York and Philadelphia, will be dissolved on Dec. 31, 1907, by the retirement of Ivy L. Lee.

CLEVELAND.

Large Coke Tonnage Sells Under $2—Low Pig Iron Quotations.

Office of THE IRON TRADE REVIEW,
Browning Bldg., Dec. 31.

Iron Ore.—With blast furnace production in its present condition, the ore traffic is practically at a standstill, and very little tonnage is moving from docks. It is not expected that any attention will be given to next year's ore transactions or to chartering until in the spring.

Pig Iron.—The ground-work continues to be laid for a buying movement in pig iron. Inquiry from many sources is good and an investigation of these forerunners of business by sellers has shown a more definite intention of closing on the part of prospective buyers. The general purpose of the melters so feeling the market is to contract for their first quarter and first half requirements by Feb. 1. As yet, however, the active inquiry has developed into practically no sales. Some small sales of spot No. 2 foundry are being made at about $17.50 local furnace and first quarter iron is held on approximately the same basis. Due to the many extensions of shipments on contracts for last half and last quarter iron, made at the request of customers, furnace interests in this territory will carry a large tonnage of undelivered metal into the new year. One interest will transfer substantially a two-months' output and this is typical of the entire situation. Though furnace men as a rule are not overly anxious to fill up with a large tonnage under prevailing conditions, occasionally an interest is prosecuting an aggressive campaign for business. Such a state of affairs, developed a low price of $15.50, western Pennsylvania furnace, this week or $17.10, Erie, Pa., the delivery point, but did not attract the order, which has remained open. Another interest declined an offer of $16.50 furnace on a lot of 1,000 tons for first half delivery. One well-known southern brand, which has been held at $14, Birmingham, has been withdrawn from the market, and the same company is showing no great willingness to close at $15.50, Birmingham, for less-famous grades. Our prices for prompt shipment, extending through January, f. o. b. Cleveland, are as follows:

Bessemer	$19.90
No. 1 Foundry	18.00 to 18.50
No. 2 Foundry	17.50 to 18.00
No. 3 Foundry	17.00 to 17.50
No. 2 Southern	17.35 to 18.35
Gray Forge	17.00 to 17.50

Coke.—The inquiry for 40,000 tons of standard furnace coke for first half delivery by a local furnace interest,

which was noted last week, has been closed. The contract calls for standard Connellsville coke and the price accepted in active competition was a little under $2, ovens. The market generally shows little change and does not exhibit much strength. For first quarter and first half delivery we quote foundry coke at from $2.75 to $3.25 ovens, the latter figure for the best grades, and furnace coke at from $2 to $2.25, ovens. For prompt delivery these prices can be shaded.

Finished Material.—An improvement in the spirit of the market is discernible in finished lines even though this statement cannot be applied to actual transactions. More inquiries are being made by users of iron and steel for their first quarter and first half requirements, including one for 800 tons of material, largely plates, for Pacific coast work. There are also some scattering plate inquiries of smaller size. The enlargement of a principal office building in this city is now being figured upon, and if the project materializes it will require several thousand tons of structural. There is a slightly better tone in bar iron. Among the recent sales is a transaction of 1,000 tons to a local manufacturer on the basis of about 1.50c Cleveland mill, and a smaller lot to a lime and stone company for industrial car construction. Several railroads are also in the market for monthly requirements. In sheets, independent mills are showing less willingness to cut prices on galvanized and cold rolled grades. Small sales of light rails are being made from time to time. The greater percentage of the capacity of metal-working plants in this district is temporarily idle, advantage having been taken of the holiday lull to complete inventories and to make arrangements to start the new year with a clean bill. These establishments are expecting to largely resume early in the new year and their needs in finished lines will then be met. Collections continue to grow better.

Old Material.—There is absolutely no movement of old material and future conditions are hard to forecast. Many iron mills are closing and dealers are meeting with difficulty in having tonnage accepted on old contracts. The Lake Shore railroad has closed on its monthly list at low prices generally, but some of the grades netted a larger figure than could be obtained on the open market, due to the fact that some dealers holding high-priced contracts were willing to pay a little more to clean up their orders by the year's end. The Michigan Central and Erie railroads are also in the market with monthly lists. Our prices, f. o. b. Cleveland, gross tons, which are largely nominal, are as follows:

Old iron rails	16.00 to 17.00
Old steel rails (re-rolling)	12.00 to 13.00
Old steel rails (under 6 feet)	12.00 to 13.00
Old car wheels	16.00 to 17.00
Old steel boiler plate	9.00 to 10.00
Steel axles	13.00 to 14.00
Malleable iron (railroad)	12.00 to 13.00
Malleable iron (agricultural)	10.00 to 11.00
Heavy steel	11.00 to 12.00
Country mixed steel	10.50 to 11.50
Low phosphorus	14.50 to 15.50

We quote net tons as follows:

No. 1 R. R. Wrought	11.50 to 12.50
No. 1 busheling	11.00 to 11.50
No. 1 machine cast	12.00 to 13.00
Iron axles	16.00 to 17.00
Axle turnings	7.00 to 8.00
Machine shop turnings	5.50 to 6.50
Grate bars	9.00 to 10.00
Pipes and flues	9.00 to 10.00
Tank iron	8.00 to 9.00
Hoop and band iron	5.00 to 6.00
Sheet iron	4.00 to 5.00
Wrought drillings	5.50 to 6.50
Stove plate	10.00 to 11.00
Cast borings	4.00 to 5.00

ST. LOUIS.

Satisfactory Inquiries for Pig Iron—Order For Box Cars and Coaches.

Dec. 30.

Pig Iron.—Inquiries during the last few days have been very satisfactory, and show conclusively that foundrymen in this territory are in the market for probably from 4,000 to 5,000 tons of iron, mostly for shipment during January and over the first quarter of 1908, some of it to be shipped over the first half of the new year. Business is being booked on the basis of $13.50 to $14, f. o. b., Birmingham, for No. 2, and it is confidently expected that a buying movement will make itself quite evident within the next two or three weeks.

Our quotations f. o. b. Birmingham, to which freight of $3.75 is to be added, follow.

No. 1	Southern	$14.50 to 15.00
No. 2	Southern	13.50 to 14.00
No. 3	Southern	13.00 to 13.50
No. 4	Southern	12.50 to 13.00

Coke.—The coke market is firm at $5 to $3.25 for future shipment, while spot coke can be obtained as low as $2.75 for 72-hour foundry select. Furnace coke, 48-hour, is being quoted at $2.25. There is no demand for smelter coke, which is quoted at from $1.60 to $2, f. o. b. ovens. The freight rate to East St. Louis is $2.80 and $2.90 to St. Louis.

Virginia 72-hour foundry coke is quoted at $3, ovens, upon which the freight rate is $2.80 to East St. Louis, $2.90 to St. Louis, and $2.40 when destined beyond. A few inquiries have been received for Connellsville coke, covering deliveries over the first and second quarter of 1908.

Finished Material.—President A. J. O'Reilly, of the board of public improvements, is preparing letters to world-known architects asking for bids for plans for the new $3,000,000 free bridge that is to span the Mississippi river between St. Louis and East St. Louis. Bids probably will not be received after Jan. 17, and the work probably will be done on commission, the architect's fees amounting to $100,000 to $200,000.

An order from J G. White & Co., of New York City, to the American Car & Foundry Co., for 23 passenger coaches and 80 box cars has also given stimulus to the steel market, although the cars will not be built at any of the company's plants contiguous to St. Louis. Fifteen of the coaches are to be third class, steel underframe; four second class, steel underframe, combination baggage and passenger coaches, and four are to be steel underframe first-class combination parlor cars. Of the box cars, 40 are to be 10-ton steel underframe, and 40 are to be 20-ton steel underframe. All of the cars are to be delivered as soon as they can be turned out. It is believed in St. Louis that the box cars are for use in Porto Rico, and they will be built at Milton, Pa. The coaches will probably be used in connection with the Philippine railway, and will be constructed at Wilmington, Del., because that point is better adapted for export trade.

Old Material.—The scrap iron market continues dull, and local dealers are not anticipating any marked betterment in the near future.

The national Enameling & Stamping Co.'s plant at Granite City, Ill., will reopen Jan. 6, giving employment to 2,000 men who have been out of work for nearly a month. The corporation is one of the largest employers of labor in Southern Illinois, and its resumption of work is taken to indicate that the financial skies are rapidly clearing, and other factories will be in full operation.

BUFFALO.

Buyers Are Hoping For Lower Prices For Pig Iron.

Office of THE IRON TRADE REVIEW,
932 Ellicott Square, Dec. 31.

Pig Iron.—The market presents the same aspect of semi-suspended animation that has characterized it for several weeks past, with all eyes turned to the future to see what the new year will bring forth. It is pointed out that, as compared with this time a year ago, when buying was active in anticipation of a further advance in prices with Jan. 1, now the situation is diametrically the op-

posite, and buyers seem to be looking for reductions. While some interests are opposed to making any further reductions in prices, claiming that to do so would be to operate at a loss, there is a disposition manifest in other quarters to beat an orderly retreat.

So while there are few sales on which to base judgment, some further reductions are to be noted, and we quote the following:

No. 1X Foundry	$18.50 to 19.00
No. 2X Foundry	18.00 to 18.50
No. 2 Plain	17.50 to 18.00
No. 3 Foundry	17.25 to 17.75
Malleable Bessemer	18.50 to 19.00
Gray Forge	17.00 to 17.50
Charcoal	25.00 to 26.00

BIRMINGHAM.

Production Still Farther Curtailed—Little Prospect of Improvement.

Dec. 30.

The pig iron make in this section is practically at a standstill. Two furnaces which were blown out a week or so ago with the understanding that this was done for the holiday period only are to be started up "within a few days," so it is announced. The blowing out of four of the old open-hearth furnaces at the steel plant of the Tennessee Coal, Iron & Railroad Co. (United States Steel Corporation) was another incident for the past week. It was announced at Ensley, where the steel plants are located, that these furnaces are to be remodeled and that the work will be taken up at once. The steel make at Ensley will be reduced some by the shutting down of these furnaces.

Positively no move has been made in the last few days that would indicate that there is going to be an immediate starting up of furnaces. Plenty of raw material is on hand, ore, coal and coke, but there is no assembling of labor or other moves being made that would indicate that the making of iron would shortly be put on the basis that attracted so much attention this way.

The big plants of the Southern Steel Co. are still down and out, so to speak. The receivers are working on the affairs of the company and for a few days there was talk of a reorganization in New York. The special master appointed by the federal court, is at work on hearings and there is likely to be litigation for some time. Many creditors of the big company have been figuring lately on some dividends on their claims, a loss of between 60 and 75 per cent being anticipated.

BRITISH IRON MARKET.

Continental Demand For Pig Iron is Falling Off—Very Little Buying.

Office of THE IRON TRADE REVIEW,
Prince's Chambers, Corporation Street,
Birmingham, Eng., Dec. 21.

The condition of the pig iron market has changed very little during the week, and today's quotation at Cleveland is 49s 7½d ($12.15), which is about 2d to 3d above that of a week ago. The week is closing rather more firmly. Buying is practically in suspense until the New Year, but in the Midlands at all events some contracts will have to be placed in view of the moderate activity at all the Midland works. Manufacturers really cannot afford further reductions. Selling prices are now barely remunerative notwithstanding the considerable fall in coke. The continental demand is at last falling off, mainly owing to a heavy drop of 10s, just decided upon in standard German brands. Up to this month, exports have not been affected, but there must be a considerable reduction by the end of December. There is still a good demand for foundry irons. Some of the Derbyshire houses have orders to last them until April and May, and such slight reductions as they make are merely to retain old customers. Eight furnaces have been blown out at Cleveland, and 12 in Scotland. The hematite trade is very bad, scarcely any business being done. Iron has been sold this week on the east coast at 64s 6d ($15.78) for mixed numbers compared with 82s 6d ($20.20) in the summer. Everyone agrees that in this line further reductions are inevitable, but opinion is far from unanimous in regard to ordinary iron, though the general feeling is, on the whole, that pig iron will be still cheaper. Northampton is selling at about 51s ($12.48).

PHILADELPHIA.

Increased Inquiry and Some Sales of Pig Causes More Cheerful Feeling.

Dec. 31.

Pig Iron.—There has been a very marked increase in the number of inquiries, especially for first quarter iron, and a number of good sized concerns are also in the market for supplies covering the entire year. As considerable iron has also been sold, there is a more cheerful feeling about the future, notwithstanding the very general cessation of activity in the trade because of the holidays. The restriction of output goes steadily on, and a careful calculation shows that not over 40 per cent of the blast furnaces east of the Alleghenies are now in operation. The number of those idle has been increased by the blowing out of the Reading Iron Co.'s Temple furnace. The Emporium Iron Co. has planned to blow out its furnace at Emporium, Pa., about the first of the year, and it is reported on good authority that the Musconcotong (N. J.) furnace will soon be put in the idle class. Prices show no essential change and may be quoted as follows:

No. 1X Foundry	$18.75 to 19.25
No. 2X Foundry	18.00 to 18.50
No. 2 Plain	17.75 to 18.25
Standard Gray Forge	16.50 to 17.00
Basic	17.50 to 17.75
Low Phosphorus	25.00 to 26.00

Finished Material.—With most of all the mills closed down until Jan. 6, there is naturally a lull in the market. Doubtless new business is slowly accumulating, and when operations are resumed, the outlook will be considerably better than it has been for some weeks. An event of local interest was the award to the McClintic-Marshall Construction Co. of a contract for about 5,000 tons of structural material required in the elevation of the Reading railway's tracks in this city. This work will go to the Pottstown plant of the company and will insure its activity for several months. For the first time since 1903 the Pencoyd plant of the American Bridge Co. has closed its steel and rolling mills, in keeping with the general policy of the United States Steel Corporation. Prices are held at schedule figures, as follows: Beams, channels and angles as according to specifications, 1.85c to 1.90c; refined iron bars, 1.75c to 1.80c; steel bars, 1.75c to 1.85c; plates, 1.85c to 1.90c.

Old Material.—Prices have sunk still lower in the absence of any demand, and are now believed to be very near rock bottom. They certainly can't go much lower without inflicting heavy losses on dealers. They may be quoted as follows:

Old steel rails	$13.50 to 14.00
No. 1 steel scrap	12.00 to 12.50
Old steel axles	17.50 to 18.00
Old iron axles	22.00 to 23.00
Old iron rails	15.50 to 16.00
Old car wheels	18.50 to 19.00
Choice scrap R. R. No. 1 wrought	14.00 to 14.50
No. 1 yard scrap	13.50 to 14.00
Machinery scrap	15.50 to 16.00
Low phosphorus scrap	16.50 to 17.00
Wrought iron pipe	11.00 to 11.50
No. 1 forge fire scrap	10.50 to 11.00
No. 2 forge fire scrap, ordinary	8.50 to 9.00
Wrought turnings	9.50 to 10.00
Axle turnings, heavy	10.00 to 10.50
Cast borings	7.00 to 7.50
Stove plates	12.00 to 12.50

Upon the application of William P. Luck, representing several manufacturers, the Schwartz Foundry Co., New Orleans, has been placed in the hands of a receiver and Charles J. Whitney has been named by the court to take charge of the company's affairs.

CHICAGO.

Improvement in Pig Iron—Lower Prices in Some Finished Lines.

Office of THE IRON TRADE REVIEW,
1362 Monadnock Block, Dec. 31.

Light rails, spikes, bolts and nuts have each been reduced $2 a ton. Cast iron pipe, and old material also have sought lower levels, the former $1 a ton, and the latter from 25 cents to 50 cents, according to grade. More than off-setting these declines, however, is the distinct improvement in pig iron. Northern foundry has advanced 50 cents a ton, and southern foundry is rapidly settling itself on the $14 Birmingham basis. A large tonnage is under negotiation today, and the prospects are that a good percentage of it will be closed. There is no improvement in the demand for finished material, but the specifications for plates, bars and sheets are unusually good, all things considered. The Illinois Steel Co., which closed down all its finishing departments at South Chicago the day before Christmas, has started up every mill with the exception of the structural. The promise of better conditions in the building line, as evidenced by the placing of contracts last week for a total of 5,000 tons of structural steel and the report of one firm that in the past ten days it has figured on jobs aggregating 60,000 tons of steel, may necessitate the early starting up of this department. The outlook for the new year is unusually good, and the prophesied improvement around Jan. 1 seems about to be realized. Bar iron specifications are heavier, and as a result the Interstate Iron & Steel Co. started up its East Chicago mill and the Republic Iron & Steel Co. its Moline mill on Monday. The meeting of the Western Bar Iron Association, to be held in Pittsburg, Jan. 7, possesses no significance so far as market conditions go. This is strictly an organization for the solution of labor questions, and the proposed meeting has been called to consider the terms of an agreement with the Amalgamated Association relative to the continuous operation of mills and other amendments to the existing agreement as may be considered necessary. Bar iron remains firm at 1.75c Chicago.

Pig Iron.—Better days seem near at hand. Inquiries are freer and a good volume of business is closing. But the most hopeful sign in the market is the changed attitude of buyers and sellers. Both sides now seem earnest in their effort to find a middle ground on which each can profitably transact business, and it begins to appear that this has been located. The recent meeting in Cleveland of the northern and southern furnace interests has simplified the producer's problem, while the improved demand for castings and the better business conditions prevailing generally has clarified the atmosphere for the foundryman. Fourteen dollars, Birmingham, for No. 2 foundry, on deliveries extending through the first half of the year, is the price that appears to have the greatest approval among producers, and is likely to be the basis on which the bulk of the current business will be placed. It is still possible, however, to get southern iron at less, and several sales have been closed in the past week at $13.00, but this quotation is fast disappearing from the market, and doubtless will be non-existent before the end of the week. In the case of northern iron, the minimum quotation of a week ago has disappeared, and $18.50 Chicago for No. 2 foundry is the very best price that can be secured today. The inquiries that have come out since Christmas not only have more substance to them, but are for larger lots, ranging downwards from 5,000 tons to carloads. It will be very surprising if a large percentage of these is not closed. Many of them have been sent out by the necessity of enforced replenishment, as practically all the stocks in the hands of foundrymen at the commencement of the slump have been used up in the interim. As further evidence of this fact, it is noted that there is less disinclination to receive shipments on contracts, and commencing Jan. 1, at which time a large proportion of the 60-day suspensions will end, these will go forward as before. There seems no possibility of further weakening in prices with so many furnaces out of blast, as henceforth production will be regulated according to demand. Fully 65 per cent of the local merchant furnaces are idle, with a greater percentage of stacks in the Birmingham district out of blast, and as all of them are carrying over into the new year a larger undelivered tonnage than is customary for this period—estimated from two to three months' output—all of it high-priced iron, there seems no necessity from the furnaceman's standpoint to force the situation any. At $14 Birmingham, and $18.50 Chicago, for southern and northern No. 2, respectively, the market is liable to rest for several weeks to come. Malleable Bessemer is holding firmly at 50 cents a ton above foundry, owing to the small stocks and curtailed production of same. Standard Bessemer has strengthened to the basis of $21.00 Chicago. We have revised our prices on high silicon irons, which are weaker in sympathy with other grades. We quote for any delivery in the first half of 1908, as follows:

Lake Superior Charcoal	$23.50 to 24.00
Northern Foundry No. 1	19.00 to 19.50
Northern Foundry No. 2	18.50 to 19.00
Northern Foundry No. 3	18.00 to 18.50
Southern Foundry No. 1	17.85 to 18.35
Southern Foundry No. 2	17.35 to 17.85
Southern Foundry No. 3	16.85 to 17.35
Southern Foundry No. 4	16.35 to 16.85
Southern No. 1 Soft	17.85 to 18.35
Southern No. 2 Soft	17.35 to 17.85
Southern Gray Forge	16.10 to 16.60
Southern Mottled	15.85 to 16.35
Southern Silveries, 4 per cent Silicon	20.35 to 20.85
Southern Silveries, 5 per cent Silicon	21.35 to 21.85
Southern Silveries, 6 per cent Silicon	22.35 to 22.85
Jackson Co. Silveries, 6 per cent	28.40 to 28.90
Jackson Co. Silveries, 8 per cent	30.40 to 30.90
Jackson Co. Silveries, 10 per cent	32.40 to 32.90
Malleable Bessemer	19.00 to 19.50
Standard Bessemer	21.00 to 21.50
Valley Basic	19.40 to 19.90
Alabama Basic	19.35 to 19.85

Billets and Rods.—For the first time in two or three years, the Illinois Steel Co., is again seeking outside business on crude steel. It is quoting $33 base Chicago on forging billets, and $31 base on rolling billets. The only transactions in crude steel this week have been in carload lots and smaller quantities, and these have been far enough apart to create scarcely a ripple on the surface. The reduction in sheet bars to $29 a ton has aroused no interest in this section, the act being considered dilatory admission of a fact that has existed for some time. Wire rods are without change at $34 Pittsburg for either Bessemer or open-hearth.

Merchant Bars.—New business is still of an intermittent character and specifications are slow in coming forward. Nevertheless, there is a buoyancy to the general situation that betokens an early improvement in general conditions. The western mills will take no concerted action as to the future, there being no association or agreement, except upon strictly labor matters, to hold the local interests together. Each will follow the dictates of its own business, shutting down or starting up as individual needs may necessitate. The Interstate Iron & Steel Co. started up its East Chicago mill Monday, after a week's idleness, the company having accumulated enough specifications in the interim and seeing enough business in sight for the immediate future to warrant this action. In some quarters, there is a disposition to invite business by offering to shade prices slightly, but among the well intrenched concerns the market is uncommonly well maintained.

Plates.—Inquiry for new tonnage is of a very light order. Western mills have pretty nearly reached the end of their rolling schedules, and unless a sharp improvement develops at an early date, more or less suspensions of operations will follow. All the finishing departments of the Illinois Steel Co. at South Chicago were shut down Tues-

day, Dec. 24, and the rail mill was the only department to start up immediately after Christmas. The company, however, has a fairly good supply of plate specifications on hand, but will complete some necessary repairs before restarting these mills. Prices are without change.

Sheets.—Despite the reduction in sheet bars, there has been no weakening in prices of the finished product, nor does it seem likely at this writing that there will be any change in the immediate future. No mill is operating to its capacity, yet there is enough business developing daily to create what might be considered in these times a healthy market. We quote:

Black sheets, Nos. 8, 9 and 10, 1.90c Pittsburg; No. 28, 2.60c Pittsburg. Galvanized sheets, No. 28, 3.75c Pittsburg. Freight to Chicago, 18c per 100 pounds for carload lots, and 21c for less than carload lots. Jobbers' prices on carload lots and less from store are as follows:

No. 10, 2.30c to 2.35c; No 12, 2.35c to 2.40c; No. 14, 2.40c to 2.45c; No. 16, 2.50c to 2.60c; Nos. 18-20, 2.70c to 2.80c; Nos. 22-24, 2.75c to 2.85c; No. 26, 2.80c to 2.90c; No. 27, 2.85c to 2.95c; No. 28, 2.95c to 3.05c; No. 30, 3.25c to 3.35c. Galvanized sheets, Nos. 10 to 16, 3.20c to 3.30c; Nos. 18 to 20, 3.30c to 3.40c; Nos. 22 to 24, 3.45c to 3.50c; No. 26, 3.65c to 3.70c; No. 27, 3.85c to 3.90c; No. 28, 4.05c to 4.10c; No. 30, 4.70c to 4.90c.

Structural Material.—The letting of the contract for the E. S. Hunter building, to be erected at the corner of Madison and Market streets, Chicago, is significant of returning confidence among building interests, since this job has been held up for some time because of the skepticism prevailing and in anticipation of securing lower prices by waiting. The steel requirements of this building will be 830 tons, the contract going to A. Belter's Sons, of this city. The government has finally awarded the contract for the erection of the Fort Snelling bridge at the army post of that name. The project involves 1,500 tons of structural material. Bayne & Hewitt, of Minneapolis, secured the general contract, and they have contracted with the American Bridge Co. for the fabrication of the material. The general contract also includes the construction of the Minnehaha Creek bridge, 328 tons. That an improvement in building conditions is becoming general all over the country is justified by the statement of the American Bridge Co. that it has figured on over 6,000 tons of new business in the past 10 days, and by the reported order for 2,000 tons of beams and channels placed with the Jones & Laughlin Steel Co. by the Minneapolis Steel & Machinery Co. Store trade is fairly good, though not brisk.

Rails and Track Supplies.—A reduction of $2 a ton in the price of light rails as well as on spikes and bolts, is the noteworthy development of the week. Business on these products is very slow, the light rail mill at South Chicago being shut down, and the change has been made in the hope that it will invite new tonnage. No contracts for standard sections have been placed with western mills in the week under review, nor have any inquiries been received. We have revised our prices, and quote as follows:

Bessemer rails, $28 to $30; less than 500-ton lots, $32; open-hearth rails, $29; light rails, Bessemer, 25 to 45-pound sections, $30; 20-pound, $31; 16-pound, $33; 12-pound, $34; and lighter sections down to 8-pound, $40, all f. o. b. mill. Track supplies vary in price according to quantity and delivery. On orders accompanying rail contracts for future delivery, we quote, f. o. b. Joliet: Angle bars, 1.65c; spikes, 1.90c to 2c; bolts with square nuts, 2.40c to 2.50c; with hexagon nuts, 2.55c. For carload lots or less, for prompt shipment, the following prices are asked: Angle bars, 2.25c to 2.75c; spikes, 2.30c to 2.40c; bolts with square nuts, 2.75c; with hexagon nuts, 2.90c.

Cast Iron Pipe.—The only letting this week was 300 tons for the city of Lincoln, Neb. In sympathy with the softness in pig iron and light demand for pipe, prices have declined $1.00 a ton. We have revised our prices and quote 4-inch water pipe, $33; 6 to 12-inch, $32; larger sizes, $31; gas pipe, $1 a ton higher.

Coke.—The movement continues dull and no encouraging signs have developed. We quote Connellsville 72-hour foundry coke at $2.65 to $2.80 and standard Connellsville furnace coke at $1.85 to $2 at the ovens.

Old Material.—The only interesting feature of the week was the disposition of the 8,000 tons of scrap offered by the St. Paul and Burlington railroads. It cannot be learned at what prices the material went, but in view of the general refusal of consumers to take on additional tonnage except at their own prices and the loaded condition of dealers' yards, it is not believed that any better prices than those quoted below were obtained. The market is undeniably weaker, and consumers are constantly pressing their advantageous position. Quite a number of the smaller dealers refuse to budge another cent, one merchant stating that he would eat his scrap before he would sell it at the prices offered. No improvement is expected, however, so long as the present open weather continues. We have revised our prices, and quote gross tons in the first paragraph as follows:

Old Car Wheels	$19.50 to 20.00
Old Iron Rails	14.00 to 14.50
Re-rolling Rails (3 ft. and over)	11.50 to 12.00
Old Steel Rails (3 ft. and under)	11.75 to 12.25
Light Section Relayers, 45 lbs. and under, subject to inspection	21.00 to 23.00
Relaying Rails, subject to inspection	19.00 to 19.50
Frogs, Switches and Guards	10.75 to 11.25
Heavy Melting Steel	10.00 to 10.50

We quote, net tons, as follows:

No. 1 R. R. Wrought	$10.00 to 10.50
No. 2 R. R. Wrought	9.00 to 9.50
Knuckles, Couplers and Springs	10.00 to 10.25
Shafting	14.00 to 14.50
Iron Car Axles	15.50 to 16.00
Steel Car Axles	15.00 to 15.50
Dealers' Forge No. 1	8.50 to 9.00
Pipes and Flues	7.50 to 8.00
No. 1 Cast, 150 lbs. and less	12.75 to 13.25
No. 1 Mill	7.00 to 7.50
Mixed Busheling (Nos. 1 and 2)	7.00 to 7.50
Country Sheet	4.00 to 4.50
No. 1 Boiler Cut	6.50 to 7.00
Boiler Punchings	10.00 to 10.50
Cast Borings	4.50 to 5.00
Mixed Borings, etc	4.50 to 5.00
Machine Shop Turnings	6.75 to 7.25
Railroad Malleable	10.00 to 10.50
Agricultural Malleable	9.00 to 9.50
Stove Plate and Light Cast Scrap	10.00 to 10.50
Old Iron Splice Bars	12.50 to 13.00

CINCINNATI.

Increased Inquiry Gives Stronger Tone to Pig Iron Market.

Office of THE IRON TRADE REVIEW, First National Bank Bldg., Dec. 31.

Pig Iron.—A distinctly steadier tone is to be noted in the market this week. The feeling that prices are near to bottom on the present decline is taking form and there is more inquiry and some sales. While recent quotations have not been actually advanced, the offerings of iron at minimum figures are not now so free and selling agents are inclined to urge buying on the part of their customers with more confidence. There is still a disposition to seek such business as presents itself with eagerness and prices may be shaded to some extent, but quotations around $13.00 Birmingham for No. 2 foundry are regarded as about as low as can be done on southern iron, while northern iron is quite steady at $17.00 furnace in the Ironton district, although $16.50 has been done during the week. Prices for southern brands are irregular. The larger producers are said to be working harmoniously and are maintaining $14.00 Birmingham. Some southern stacks outside of the Birmingham district are demanding $13.50, and the $13.00 price is quoted quietly. A fair tonnage of prompt iron was moved this week at rather low figures, but forward deliveries at minimum quotations are not now so easily obtainable. Some investment buying is not unlikely, if the iron can be obtained at near the inside quotation for extended delivery. Some consumers are asking for prices for deliveries running through the year and one such request for prices covers 1,300 tons. An Indiana melter wants 1,100 tons for first half delivery. There is another 400-ton lot being figured on for January shipment. An inquiry for 4,000 tons of No. 2 foundry and 4,000 tons of No. 4

foundry to go to an eastern plant is under consideration. The aggregate inquiry is sufficient to give the market a stronger tone in addition to the steadier attitude of the furnaces. January is expected to develop more order placing. The general condition of the foundry trade does not seem to justify expectation of large buying, but an improvement over the exceedingly dull and lifeless market so long prevalent is regarded as likely. There are reports of further curtailment of production in northern irons. We quote for prompt delivery, delivered Cincinnati, as follows:

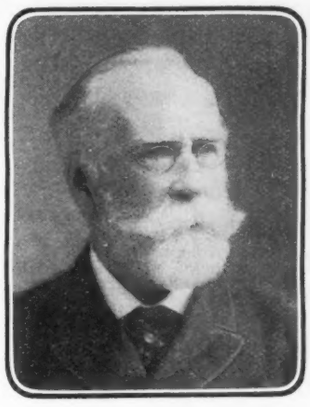
Southern Foundry No. 1	$16.75 to 17.25
Southern Foundry No. 2	16.25 to 16.75
Southern Foundry No. 3	15.75 to 16.25
Southern Foundry No. 4	15.25 to 15.75
Southern No. 1 Soft	16.75 to 17.65
Southern No. 2 Soft	16.25 to 16.75
Southern Gray Forge	14.75 to 15.25
Northern No. 1 Foundry	18.20 to 18.70
Northern No. 2 Foundry	17.70 to 18.20
Northern No. 3 Foundry	17.20 to 17.70
Northern 8 per cent Silicon	22.70 to 23.20

COLEMAN SELLERS DEAD.

Dr. Coleman Sellers, scientist, inventor and engineer, died at his home in Philadelphia on Dec. 28 at the age of 81 years. Dr. Sellers suffered from a general physical breakdown.

Coleman Sellers was born in Philadelphia, Jan. 28, 1827. He was the son of Coleman and Sophonisba (Peale) Sellers. He attended private schools in Philadelphia until his 12th year when he went to the academy of Anthony Bolmar at West Chester, Pa., finishing the course at the age of 17. When he was 19 he was engaged by his elder brothers as a draftsman in the Globe rolling mills at Cincinnati. By familiarizing himself with all the processses employed in the mills and by suggesting and introducing simplifications and improvements, he was within two years, and before he attained the age of 21, appointed superintendent and general manager.

Leaving the Globe rolling mills, he engaged with his brothers in building hill climbing locomotives for the Pennsylvania railroad, and although the engines were successful from an engineering standpoint, they were not commercially so. After the failure of this enterprise, Coleman Sellers went with Niles & Co., locomotive builders in Cincinnati, as foreman in 1851. In 1856 he returned to Philadelphia to take charge of the drafting room of the firm of William Sellers & Co., manufacturers of machinery and machinists' tools. He remained with this company for more than 20 years, attaining the position of chief engineer and being admitted to partnership in 1873. During this time he took out 30 patents for mechanical inventions, many of which are widely known and used today. His inventions outside of the mechanical arts were numerous. He was the first person to think of and use absorbent cotton for surgical purposes. This was in 1861. In 1858, he made many improvements in the art of photography and in 1861 patented the kinematoscope, an apparatus for the exhibtion of stereoscopic pictures in motion. This was a forerunner of the modern moving picture machines, whose development was only made possible by the perfection of instantaneous photography. He was one of the founders of the Philadelphia Photographic Society and contributed largely to the press on this subject. A



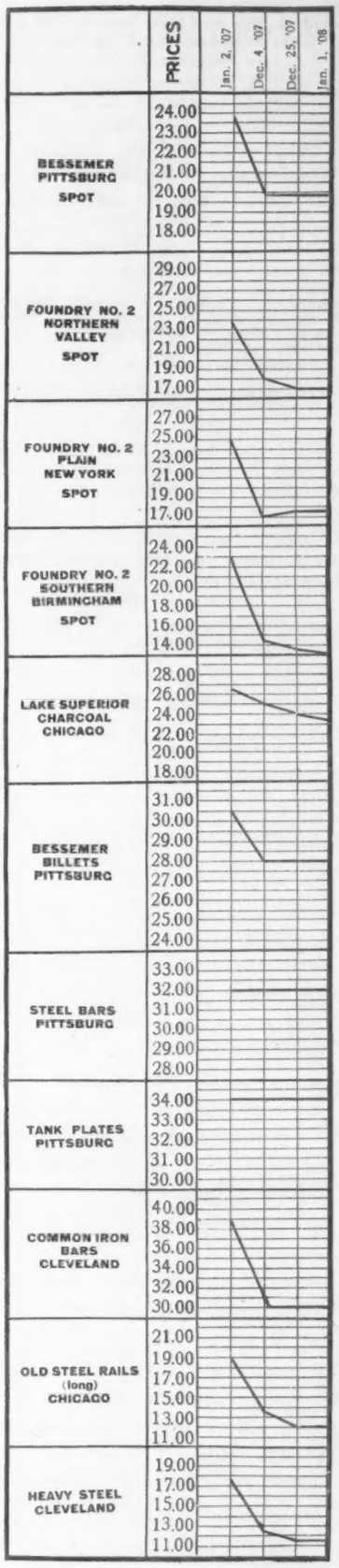
DR. COLEMAN SELLERS.

study of boiler scale by means of the microscope led to the invention of many useful aids for microscopy and to the application of the microscope to lantern work.

In 1886, Coleman Sellers retired from active interest in the business of William Sellers & Co., and devoted himself to private practice as a consulting mechanical engineer. At this time he was invited to become a non-resident member of the faculty of the Stevens Institute of Technology and lectured on the subject of engineering practice. In 1887 that institution conferred on him the honorary degree of doctor of engineering. In 1889 he received the same degree from the University of Pennsylvania.

In 1889 Dr. Sellers was called upon to consider the practicability of generating electricity by water power and of utilizing Niagara Falls for the generation and transmission of electric power to Buffalo, reporting favorably on the project. In connection with the late Lord Kelvin he served on the International Niagara Commission established in 1890 and acted as engineering head of the work. The important mechanical features of the dynamos used in this installation are of his design and invention.

PRICE CHART.



THE IRON TRADE REVIEW

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DIRECTORY NUMBER.

The first issue of the new year of THE IRON TRADE REVIEW is a directory number, representing an effort to serve the many readers who are buyers of iron and steel products and machinery, and to present reviews of all important events in the trade during the old year and of progress in engineering lines. The narration of the ups and downs of the markets makes a most interesting story; the advertising pages represent a wide range of products, and are a manifestation of the confidence of the advertisers in the value of printers' ink during periods of depression as well as in prosperous times.

The technical features of this issue are of unusual character and demand attention. Two articles on blast furnace practice are especially worthy of note. These are the contributions of Mr. Porter and Mr. Junge. Mr. Porter's article dealing with the recent progress and present problems of blast furnace practice is a remarkable exposition of the close inter-relation between the theory, as worked out in the laboratory, and the actual practice at the furnace. Mr. Junge deals with a subject which has been attracting the attention of American engineeers for some time past—the utilization of waste gas from furnaces of various types, the blast furnace being the most prominent. This problem was taken up in Germany long before it was considered in this country, and the advances made there afford the best field of study. Mr. Junge's facts and arguments are the result of a trip to Germany the past summer, and his conclusions, therefore, are based on the most recent practice.

It is interesting to note that the sale to outsiders of electric power generated by means of waste gases is recommended by Mr. Junge as the rational method of disposing of the power developed over and above that required by the plant itself. Taken in connection with the article by Mr. Dean, also in this issue, on the electric driving of rolling mills, it indicates the lines along which the development of gas power should be carried. Mr. Dean argues in favor of the steam turbine as a generating unit, using steam made in boilers burning the waste gases. The advantage offered by the undenied superior heat efficiency of the gas engine is more than counterbalanced, he claims, by the greater reliability and overload capacity of the steam driven unit, and by the fact that a high reserve capacity for breakdown service is unnecessary, and this is the crux of the whole subject. The nature of a blast furnace or rolling mill plant is such that *it must run.* Shutdowns of any great length due to accidents to machinery, cannot be tolerated, and the wise manager will put in that power plant which will give him unfailing service even at the sacrifice of a certain gain in economy.

A close study of the two articles, however, will reveal that they are in accord when considering the same conditions. Mr. Dean bases his calculations on a plant drawing its power supply for rolling mills from its own blast furnaces. Mr. Junge deals with a plant which has use for only about one-third of its available power. Both agree that when such a large surplus is available for sale, the economical method is to use the internal combustion motor as a prime mover and generate and sell electricity. The element of reliability does not then enter into consideration to any great extent, as in the event of the failure of the plant's own engines, electric power can be drawn from the mains to which the surplus is usually supplied; the supposition in this case is that electric power is delivered to the mains from a number of independent sources, such as other furnace plants or a central station, and that these can carry an overload long enough to permit of repairs to the temporarily disabled plant.

An article, less technical in character, but no less valuable in its field, is Mr. Stephan's contribution on modern hoisting and conveying systems. Only those engaged in the manufacture and sale, or who have made a study of the subject, can realize the magnitude to which this branch of engineering has grown in the past few years. It is a highly specialized industry, and even a bare outline of the field, which was all that the limits of our space has enabled us to present here, is valuable, instructive and interesting.

The foundry industry has received good attention. Mr. Kershaw writes on the use of electricity for melting, and while the method at first glance, is impracticable, he shows that under certain conditions it may be not only feasible but economic. The McHaffie system of steel castings is touched on in a description of the Keystone steel foundry at Chester, Pa., and the development of the steel casting industry is ably set forth by W. M. Carr.

In the machine tool line we present two remarkable planers, showing that the end of machine tool development has not yet been reached. In addition to the above, there are a host of other articles on miscellaneous subjects which cannot be enumerated here

but which are well worth attention.

We venture the opinion that, as a whole, this number has more than usual value for reference purposes, but we believe that ever copy of THE IRON TRADE REVIEW is worth keeping and we trust that, beginning with this issue, many subscribers will follow the plan long ago adopted by many others, of keeping their papers for binding.

CONDITIONS FAVORING THE RETURN OF PROSPERITY.

Some conditions prevailing in the industrial and financial world create a strong reason for the belief that the present depression will not be so severe or so prolonged as that of previous periods of inactivity in the history of the country. We may summarize these briefly as follows:

1. The prosperity of the farmer. Unless crops are at least fair, prosperity of the country will always rest on insecure foundations, but when crops are abundant, it becomes a comparatively easy task to overcome unfavorable financial conditions. The farmers comprise about one-third of the wage earners of the United States anl are constantly becoming more important consumers. The increase in the consumption of wire goods, for instance, by the agricultural classes, is far from an insignificant item. Under the wise administration of the present secretary of agriculture, Mr. Wilson, the diversifying of farm products has been encouraged, and the failure of any particular crop has been made less important, forming, as Mr. Wilson expresses it, a kind of national insurance. While the corn crop of 1907 was not so large as that of 1906, its value was greater. The value of the cotton crop was below that of 1906, but considerably larger than the average crop of a number of years. The value of the wheat crop in 1907 was above the average of the preceding five years. The value of poultry and eggs in 1906 was greater than that of wheat; the dairy products exceeded in value any crop except corn.

The following facts collected by agricultural journals are of interest:

Kansas looms up as one of the gigantic business centers, with the enormous amount of $200,000,000 worth of grain and other products ready for market and $165,000,000 in the banks with which to move the crops. Kansas farmers never have known such a crop or such large bank rolls.

The *Dakota Farmer* reports business conditions in the Dakotas better than ever before. South Dakota produced $15,000,000 more crops in 1907 than in 1906. The latest complete figures, taken Sept. 1, show bank deposits in South Dakota of $57,769,000, or $12,723,000 more than the year before.

The *Nebraska Farmer* reports the hay crop valued at $38,000,000, the largest ever produced in the state, and a total value of $170,000,000 on the eight principal crops only $4,000,000 behind 1906, Nebraska's banner year.

In Iowa, *Wallace's Farmer* reports a corn crop of 300,000,000 bushels, high in price. A better hay crop than was expected is bringing good prices, and the oat crop is good. The *Fruit Grower*, St. Joseph, Mo., reports a better corn crop than Iowa has seen in "many a day" was harvested.

During the prevailing depression, farm products of the value of $7,000,000,000 are being removed to the consumers. The irrigated area of the United States is now 11,000,000 acres, on which the crops grown in 1907 are worth $175,000,000, an increase of 75 per cent in eight years. Next year 5,000,000 more acres will be made fit for farming by the irrigation method. With such facts and such prospects the prosperity of at least one-third of the population cannot seriously be disturbed, and the effect of this prosperity upon the remaining two-thirds of the people must be highly beneficial.

2. Although the banks have not been free from blame in contributing to the money stringency, they have learned much by experience. A failure like that of Walsh in Chicago brought them into closer co-operation, and while in the panic of 1893 some 550 banks and other financial institutions failed in a few months, comparatively few failures have been reported among banks since the present period of depression set in. The quickness and harmony with which the banks have acted in increasing the volume of substitutes for currency and in coming to each other's assistance when necessity demanded, have demonstrated that they are able to accomplish much toward preventing financial disaster.

3. The establishment of the country solidly on the gold basis. During the panic of 1893, and also during the depression which came about 11 years later, the gold standard had not been established, and to this fact could be attributed much of the disaster and a great deal of the uneasiness which prevailed in the business world. Much remains to be accomplished by legislation, but having settled the primary question of the basis, the creation of an elastic system of currency should be comparatively easy, and will, we believe, be accomplished at a not far distant date.

4. The policy of curtailment of production is now being carried out more promptly and intelligently than ever before. This is being done without any greater hardship than absolutely necessary to the working man. Some of the largest concerns have made no wage reductions, although in previous periods of depression these immediate reductions have been as great as 25 per cent. There has been no overproduction; the railroads have not built more track than they needed, and in few cases is there a large surplus of products on hand.

5. Business men by association, formal and informal, are acting more harmoniously than ever before, and are discouraging competition as was never before done. In other periods of depression, salesmen have been urged to take orders regardless of price. At the present time, many firms are urging their salesmen to subordinate the taking of orders to the work of creating a feeling of confidence among their customers. Countless meetings have been held to devise ways and means of preventing destructive competition, and while agreements will be violated, as in past years, the general result promises to be much more satisfactory than ever before.

6. The wear and tear of rolling stock on the railroads and of machinery in other industries, even in time of depression, prevent indefinite postponement of buying, and the fact that machinery has been put to very severe usage for a number of years will hasten the time when this buying must be commenced. For instance, of the many blast furnaces which are now becoming inactive, there are few upon which extensive repairs are not necessary, and the making of these repairs is bound to keep a large number of men busy.

With one-third of the wage earners busy on the farms and happy, and another one-third belonging to classes not seriously affected by financial troubles, only one-third of the wage workers will suffer to any great extent, but we are frequently told that the presidential election, labor troubles and other more or less obscure causes will prolong the depression. We see nothing, however, in the horizon of labor or politics or elsewhere to dispel the hope arising from a calm consideration of the encouraging features of present conditions.

The Interstate Iron & Steel Co., Chicago, has added to its present line of sizes in light channels the following additional sizes: ¾-inch, 1-inch, 1¼-inch and 1½-inch. It will be able to fill specifications for these after the first of the year.

GREAT TONNAGE

OF IRON ORE ON LOWER LAKE DOCKS.

Present Stock on Hand of 7,385,728 Tons Exceeds Any Year in History—More Than Ample for Winter Smelting.

The figures compiled by the *Marine Review* from the returns sent in by the various dock companies show that iron ore receipts at Lake Erie ports during the season of 1907 were 35,195,758 tons, out of a total movement of ore by lake of 41,288,755 tons. Lake Erie docks on Dec. 1 held a balance of 7,385,728 tons, which is the largest store on hand in the history of the traffic, the previous high figure being in 1902 when 7,074,254 tons were at hand. During 1906 the total shipment by lake was 37,513,595 tons, of which Lake Erie docks received 32,076,757 tons and held a balance on Dec. 1, 1906, of 6,252,455 tons. During 1905 the total shipment by lake was 33,476,904 tons, of which Lake Erie docks received 28,941,259 tons and held a balance on Dec. 1, 1905, of 6,438,967 tons. The reserve of 7,385,728 on Lake Erie docks Dec. 1 is ample for winter consumption. Never in the history of the trade has 5,000,000 tons gone forward from dock to furnace during the winter season, and moreover, furnace stock piles are abundant.

Shipments to furnaces between May 1 and Dec. 1, 1907, aggregate 29,787,018 tons compared with 27,615,392 tons in 1906, compared with 24,311,720 tons in 1905, with 16,658,806 tons in 1904, with 16,903,013 tons in 1903, with 18,423,364 tons in 1902, and with 14,204,596 tons in 1901.

The shipments to furnaces during the season of navigation as referred to are determined in this way: First we have the amount of ore on Lake Erie docks before the opening of navigation May 1 last, 1,976,988 tons; add to this the receipts of the season just closed, 35,195,758 tons, and the total is 37,172,746 tons; deduct the amount on dock Dec. 1, 7,385,728 tons, and we have 29,787,018 tons as the amount that was forwarded either direct or from dock to furnace yards. It is, of course, understood that the difference between the total output of 41,288,755 tons, which was shipped from the Lake Superior mines during 1907, and the receipts of 35,195,759 tons at Lake Erie ports, is ore that went to places other than Lake Erie ports, such as the furnaces at Detroit and South Chicago. The accompanying table shows receipts at Lake Erie ports and amounts on dock during six years past:

Iron Ore Receipts at Lake Erie Ports, Gross Tons.

Ports.	1907.	1906.	1905.	1904.	1903.	1902.
Toledo	1,314,140	1,423,741	1,006,855	508,792	652,305	1,037,571
Sandusky	83,043	35,847	51,202	48,356	130,532	165,556
Huron	971,430	778,453	825,278	231,364	486,106	520,646
Lorain	2,621,025	2,191,965	1,605,823	972,931	990,490	1,442,417
Cleveland	6,495,998	6,604,661	5,854,745	3,572,228	4,434,160	4,873,318
Fairport	2,437,649	1,861,498	2,008,621	1,157,858	1,434,342	1,538,744
Ashtabula	7,521,859	6,833,325	6,373,779	3,639,250	4,242,160	4,796,805
Conneaut	5,875,937	5,432,370	5,327,552	4,083,655	3,903,937	4,300,301
Erie	2,294,239	1,986,539	2,112,476	1,284,778	1,257,798	1,717,268
Buffalo & Tonawanda	5,580,438	4,928,331	3,774,928	2,433,601	2,194,901	2,356,798
Total	35,195,758	32,076,757	28,941,259	17,932,814	19,681,731	22,649,424

Iron Ore on Lake Erie Docks, Dec. 1, Gross Tons.

Ports.	1907.	1906.	1905.	1904.	1903.	1902.
Toledo	518,645	281,000	368,024	318,573	106,710	310,023
Sandusky	44,546	17,467	52,977	75,134	95,275	95,175
Huron	415,730	245,499	208,023	182,495	253,249	232,767
Lorain	366,271	336,321	271,695	299,504	288,581	328,304
Cleveland	1,281,335	1,224,606	1,330,619	1,237,033	1,337,750	1,500,604
Fairport	523,981	590,783	759,961	660,420	845,946	924,236
Ashtabula	2,056,820	1,631,312	1,589,951	1,403,575	1,911,911	1,967,136
Conneaut	1,090,774	1,057,424	976,976	684,487	591,364	673,679
Erie	652,219	552,631	564,961	583,439	657,409	722,966
Buffalo	435,407	315,412	315,780	318,739	282,890	319,367
Total	7,385,728	6,252,455	6,438,967	5,763,399	6,371,085	7,074,254

NEW DISTRICT COMMITTEES OF THE N. F. A.

The new district committees of the National Founders' Association have been completed and announced as follows:

FIRST DISTRICT.—A. W. Whitcomb, Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass., chairman; A. N. Abbe, P. & F. Corbin Co., New Britain, Conn., vice chairman; F. D. Wanning, Birmingham Iron Foundry, Derby, Conn.; J. D. Hunter, James Hunter Machine Co., North Adams, Mass.; James F. Lanigan, Davis Foundry Co., Lawrence, Mass.

SECOND DISTRICT.—T. L. Richmond, Buffalo Scale Co., Buffalo, N. Y., chairman; F. E. Wheeler, International Heater Co., Utica, N. Y., vice chairman; G. H. Johnson, Isaac G. Johnson & Co., Spuyten Duyvil, N. Y.; D. E. Titsworth, Potter Printing Press Co., Plainfield, N. J.; H. D. Miles, Buffalo Foundry & Machine Co., Buffalo, N. Y.

THIRD DISTRICT.—Thomas E. Durban, Erie City Iron Works, Erie, chairman; I. H. Schwacke, William Sellers & Co., Inc., Philadelphia, vice chairman; Stuart R. Carr, Stuart R. Carr & Co., Baltimore; W. R. McClave, McClave-Brooks Co., Scranton, Pa.; Thos. Shipley, York Mfg. Co., York, Pa.

FOURTH DISTRICT.—Irving H. Reynolds, William Tod Co., Youngstown, O., chairman; Walter S. Russel, Russel Wheel & Foundry Co., Detroit, vice chairman; R. H. Jeffrey, Jeffrey Mfg. Co., Columbus, O.; William Gilbert, Buckeye Foundry Co., Cincinnati, O.; Omar N. Steele, American Ship Building Co., Cleveland.

FIFTH DISTRICT.—W. H. Winslow, Winslow Bros. Co., Chicago, chairman; J. W. Gardner, Gardner Governor Co., Quincy, Ill., vice chairman; C. R. Stephens, Moline Plow Co., Moline, Ill.; T. R. Kackley, Atlas Engine Works, Indianapolis; William Medart, Medart Pulley Co., St. Louis.

SIXTH DISTRICT.—George C. Forgeot, Allis-Chalmers Co., Milwaukee, chairman; A. J. Brawley, South Park Foundry & Machine Co., St. Paul, vice chairman; George H. Smith, George H. Smith Steel Casting Co., Milwaukee; Theo. H. Vilter, Vilter Mfg. Co., Milwaukee; Oliver Crosby, American Hoist & Derrick Co., Milwaukee.

SEVENTH DISTRICT. — H. Cockshutt, Cockshutt Plow Co., Ltd., Brantford, Ont., chairman; Edgar McDougall, John McDougall Caledonian Iron Works Co., Montreal, Que., vice chairman; R. J. Whyte, Frost & Wood Co., Ltd., Smith's Falls, Ont.; Frederic Nicolls, Canada Foundry Co., Ltd., Toronto, Ont.; John M. Taylor, Taylor-Forbes Co., Ltd., Guelph, Ont.

EIGHTH DISTRICT.—E. A. Watson, Caldwell-Watson Foundry & Machine Co., Birmingham, Ala., chairman; Exile Burkitt, Southern Engine & Boiler Works, Jackson, Tenn., vice chairman; D. T. Smith, Continental Gin Co., Birmingham, Ala.; G. T. Thayer, South Side Foundry & Machine Works, Charleston, W. Va.

HONORARY.—William H. Pfahler, Philadelphia.

UNIFORM FOUNDRY CONTRACT BEING CONSIDERED.

There appears to be but little change in the situation of the Cincinnati machinery trade. A few scattered orders are dropping in and the shops are running along on unfilled orders taken some time ago. As these orders come through, some stock is being made. The first of the year and the developments succeeding the holiday season are waited with much interest. A resumption of buying is expected to develop soon after the first of the year by many of the manufacturers of machine tools. It is remarked along the line that there is an unusual adherence to prices in spite of the dullness of the trade, and sellers appear to be willing to sacrifice business rather than cut to secure it. This gives evidence of strong financial position as it is not a case of selling to obtain money for necessity and this policy is one of the encouraging features of the situation.

The matter of foundry contracts is now under consideration with actual placing of contracts for the new year, but some of these contracts are held in abeyance pending the settlement of the uniform castings contract form which is under discussion by both the machine tool builders and the foundries. As yet the matters involved have not been brought to satisfaction of both interests, but it is believed that the result will be a better understanding of both sides of the question. Another matter that the uniform contract proposition brings out is that with the form before them the two parties to a contract will have brought to their attention all the points likely to arise in such matters and they can be discussed and a contract drawn which will be calculated to reduce the likelihood of misunderstanding during the life of the contract.

SHIP CONSTRUCTION

AT GREAT LAKE YARDS IN 1907.

Fifty-Five Vessels Launched in Year and Forty-Two Now Building—Steel Companies Not Increasing Fleets.

The ship yards of the great lakes have 42 vessels under construction for 1908 delivery, including 26 bulk freighters, two passenger boats, two package freighters, two fireboats, two dredges, one carferry, one fuel lighter, one lightship, one tug, one sandsucker and three hopper barges. Of this program the American Ship Building Co. is building 20; the Great Lakes Engineering Works, nine; the Toledo Ship Building Co., two; the Manitowoc Dry Dock Co., three; the Racine Boat Mfg. Co., two; the Polson Iron Works, three, and the Collingwood Ship Building Co., three. Of the 26 bulk freighters, the American Ship Building Co. is building 17, the Great Lakes Engineering Works, seven, and the Toledo Ship Building Co., two. This list includes the Caldera, which was launched on Saturday last at the Bay City yard of the American Ship Building Co., and the Kopp, which was launched a couple of weeks ago at the Ecorse yard of the Great Lakes Engineering Works.

With the exception of the B. F. Berry, building at the Lorain yard of the American Ship Building Co., and which will be launched in a week or two, the Caldera and Kopp are the only two vessels intended for 1907 delivery which are carried over into the 1908 ship building program. The American Ship Building Co. is rebuilding the City of Cleveland which would have been delivered in June, 1907, had it not been for the fire. The program of the Great Lakes Engineering Works includes the two package freighters building for the Rutland Transit Co. which figured in last year's program. Omitting the Caldera and the Kopp, the remaining 24 bulk freighters for 1908 delivery have a carrying capacity of 204,700 tons on a single trip or 4,094,000 tons in an average season of 20 trips.

Independents Are Building.

Forty bulk freighters were put overboard in 1907, having a carrying capacity of 368,000 gross tons on a single trip or 7,220,000 tons in an average season of 20 trips. In the past six years vessels having a gross carrying capacity of 29,733,200 tons in a full season have been added to the lake fleet. The 1908 program will increase this to 33,867,200 tons, which is greater than the total movement of ore in any one year up to 1905. It is interesting to observe that with the exception of the Tonawanda Iron & Steel Co. none of the great ore-producing and steel-making companies figure in the 1908 program. The vessels are all building for independent interests.

In addition to this excellent program of new construction, the shipyards have an unusual variety of repair work on hand, much of it very extensive. Repair work will figure especially in the activity of the Toledo Ship Building Co. Last winter this company was very busy with repair work, but this winter it will be twice as busy and will have all that it can possibly do to deliver the vessels by the time navigation opens. This yard has been especially designed for rapidity and economy in repair work. Twenty-two vessels are now awaiting repairs at the yard, fourteen of which will have to be dry docked.

The ship yards on the great lakes did a tremendous amount of work in 1907 under most adverse circumstances, being harassed by labor troubles necessitating the closing down of some of the yards altogether and the operation of the rest of them under reduced forces. Work is being gradually resumed now, however, though the yards are not as yet in full operation. Considering this great handicap, it was a prodigious thing to put 55 vessels into the water, 40 bulk freighters, two package freighters, one passenger steamer, one wrecker, one lighter, one mailboat, five tugs and four scows.

Receivers Appointed.—On application of the bondholders, Judge Lanning, of the United States circuit court, at Trenton, N. J., has appointed John R. Lee, vice president of the company; Oakley W. Cook and William Arnold, a minority bondholder, as receivers of the Passaic Steel Co., Paterson, N. J., under bond of $150,000. The application for receivers, which was made by Joseph O'Brien and Michael Martin, both of Scranton, alleged that the company is in arrears on the interest of its bonds and its taxes.

January Meeting of A. S. M. E. — The regular monthly meeting of the American Society of Mechanical Engineers will be held Tuesday evening, Jan. 14, in assembly room No. 1, of the Engineering Societies' building, New York. The subject will be "Car Lighting," the presentation being made by R. M. Dixon, president of the Safety Car Heating & Lighting Co., and will treat of the general subject of light of trains.

RAILWAY CONSTRUCTION

In United States in 1907 Makes Fine Showing Despite Conditions.

While railway construction in the United States in 1907 did not reach the total new mileage laid in 1906, the record of the past year is a very notable one considering the financial depression which had restrained development work in all lines during the latter part of the period. Had numerous projects started in 1906 and 1907 been permitted by commercial conditions to have been carried to completion, the past year would undoubtedly have proven a banner one in American railroad building.

The number of miles of new railway added in 1907, as shown by the figures compiled by the *Railway Age*, is 5,874. The new mileage is the largest added in a single year with the exception of 1906 since 1888. In 1906, there were laid 226 more miles than in 1907. The largest total of new trackage reported by a single state is from Louisiana, where 422.41 miles were laid in the year; South Dakota is second with 385.83; Texas third with 381.09, and Florida with 320 and Washington with 311.01 followed.

As to geographical division, the northwestern states show the greatest new railway development, their total mileage was 1,169.88, against 1,025.77 in the Pacific states, 1,007.70 in the South Atlantic states, 988.58 in the southwestern states, 970.72 in the gulf and Mississippi valley states, 418.69 in the central and northern states, 254.82 in the middle Atlantic states, and 38.09 in the New England states. Of the country's total new trackage 61½ per cent was constructed in the territory west of the Mississippi river, comparing with 70 per cent of all new work in 1906. The increase in mileage each year for the past 21 years is shown in the following table:

Year.	Miles.	Year.	Miles.
1887	12,983	1898	3,083
1888	7,106	1899	4,588
1889	5,230	1900	4,437
1890	5,670	1901	5,222
1891	4,281	1902	5,684
1892	4,192	1903	5,786
1893	2,635	1904	4,252
1894	1,949	1905	5,000
1895	1,803	1906	6,100
1896	1,848	1907	5,874
1897	1,880		

As to new equipment ordered during the past year, the statistics compiled by the *Railway Age* show the following summary in locomotives, passenger cars and freight cars.

	1905.	1906.	1907.
Locomotives	6,265	5,642	3,482
Passenger cars	3,289	3,402	1,791
Freight cars	341,315	310,315	151,711

The Columbus Iron & Steel Co. blew out its furnaces at South Columbus, Jan. 1. Both stacks will remain idle until such time as the market improves.

Review of Financial History of 1907

How absolutely, the present iron and steel capacity of the United States owes its existence and serviceableness to a continued public faith in the future of the nation and its needs, is forcibly illustrated by a retrospect of the momentous financial conditions of the year 1907. Beginning the year with abounding prosperity and with no visible cloud to mar the bright prospects of the future, the iron and steel trade had moved confidently into a period of unsurpassed activity and production. The early months of the year saw all expectations fulfilled. Plants were operated to the fullest extent, a further enlargement of the country's output seemed amply justified and in the eyes of some, the iron and steel industry was strongly entrenched against business depression. Arising from commercial abuses and excesses of long-continued practice, but contributed to only slightly by the errors of the iron and steel trade itself, the financial situation at this point, began to display danger signals. With the approach of March, the onset of a heavy movement of liquidation was put in action in the stock market and the effects became increasingly severe as the year advanced. Stocks gradually sank to lower price levels until in October the lowest quotations in standard railroads and industrials that had ruled in the market for a long term of years, were reached. Hoarding of cash by individuals and institutions was resorted to and as money became scarce, premiums on currency appeared, leading to the issuance of clearing house certificates and the adoption of other emergency measures. Call funds commanded as high as 100 and 125 per cent and often borrowers were fortunate in being able to obtain accommodations even at these figures. The iron and steel trade, affected adversely by the stringency along with other business interests, found itself forced to a policy of sharp curtailment and the spectacle of its plunging from the height of prosperity to the depth of depression in a few months' time was soon presented As the shock, which public confidence had received, became more plainly apparent, the paralysis of the trade so continued until in its completeness it has never been exceeded in the last decade of the industry and has only been approached by the business decline of 1903.

On the threshhold of the new year it is apparent that the money market has about reached an adjustment, following the abnormal development of the past year. Likewise the iron and steel industry has brought itself to a basis of equilibrium and stands ready to resume active operations the moment the outlook so justifies. The passing financial depression has taught its lessons. It has again emphasized the time-honored need of a more elastic currency; it has shown the defects in the present legislation surrounding banking operations and, above all else, it has demonstrated to the nation, the essential importance of individual confidence in the preservation of the general prosperity. But the admirable manner in which the crisis has been handled by business interests, large and small, and the alertness of the government in lending aid at critical times, provides a source of congratulation and if the general view may be accepted, of eventual good that should result, the depression of 1907 may be said to have not been in vain.

The accompanying table, presenting the price changes in leading industrial securities, at the close of the year 1907 over the corresponding date in 1906, clearly illustrates the length to which the decline in securities has extended.

THE LEADING INDUSTRIAL SECURITIES.

	Closing Quo Dec. 28 1907	Closing Quo. Dec. 29. 1906.	Changes in Year 1907	Return on Investment Per Cent	Dividend Basis	Dividend Last Declared	Dividend Date Last Div. Pay.
Allis-Chalmers	5½	16¾	—11¼	.....	.....	.....	.....
Allis-Chalmers pr	17	44¾	—27¾	.....	7 cum	1¾ Q.	Feb., 1904
American Can	4	5⅞	— 1⅞	.....	.....	.....	.....
Am. Can pr	41⅜	54	—12½	12 0	7 cum	1¾ Q.	Oct , 1907
Am. Car and Fdy	31	42⅞	— 9⅞	12.8	1 Q.		Oct., 1907
Am. Car and Fdy pr.	83¼	101	—17¾	8.4	7 n. c.	1¾ Q.	Oct., 1907
American Loc.	34½	72⅜	—37⅞	14.4	5	1¼ Q.	Nov. 1907
American Loc. pr	86½	108½	—22	8 1	7 cum	1¾ Q.	Oct., 1907
American Ship	44½	75	—30⅞	9 0	4	3	Sept. 1907
American Ship pr	85	109	—24	8 2	7 n. c.	1¾ Q.	Oct., 1907
Am. Steel Foundries	6⅜	11	— 4⅜	.....	.....	.....	.....
Am. Steel Foundries pr	28½	45⅜	—17⅜	.....	6 cum	2¼	Aug., 1904
Barney & Smith	65	70	— 5	6 1	4	1 Q.	Sept ,1907
Barney & Smith pr.	128⅛	140	—11½	6.2	8 cum	2 Q.	Sept.,1907
Bethlehem Steel	8½	19	—10½	.....	.....	.....	.....
Bethlehem Steel pr.	23	60	—37	.....	7 n. c.	¾ Q.	Feb., 1907
Cambria Steel	27	37⅝	—10⅝	11.0	6	1½ S. A.	Aug ,1907
Cambria Iron	43	47⅛	— 4½	9 44	4	2 S. A.	Apr.,1907
Chicago Pneumatic Tool.	22	49¼	- 27¼	18.1	4	1 Q.	Oct , 1907
Colorado Fuel	19	53½	—34½	.....		3¼	Apr..1902
Crucible Steel	6	11¼	— 5¼	.....	.....	.....	.....
Crucible Steel pr.	55¾	76¾	—21¾	10.8	7 cum	1¾ Q.	Oct., 1907
Empire Steel	5	6	— 1	.....	.....	.....	.....
Empire Steel pr	52	50	+ 2	.....	6 cum	3 S. A.	July, 1906
Fay & Egan	100	100	.....	6 0	6	1½ Q.	July. 1907
Fay & Egan pr.	128⅛	128¼	.....	7 0	7 cum	1¾ Q.	Aug.,1907
General Electric	112	159⅞	—47⅞	7.1	8	2 Q.	Oct..1907
Harbison-Walker	14½	13¾	+ 1¼	13 8		½	Oct..1907
Harbison-Walker pr.	99½	80	—10½	8.6	6 cum	1½ Q.	Oct.,1907
International Pump	13½	38⅛	—25	.....		1	Apr.,1905
International Pump pr.	65½	80⅜	—15⅝	9 2	6 cum	1½ Q.	Aug.,1907
Lackawanna Steel.	24	71	—47	.....	.....	.....	.....
Lake Sup. Corp.	3¼	15	—11¾	.....	.....	.....	.....
New York Air Brake	51½	137¼	—86¼	15 5	8	2 Q.	Oct., 1907
Niles-Bement-Pond	130	130	.....	6 0	6	1½ Q.	Dec., 1907
Niles-Bement-Pond pr.	105	105	.....	6 0	6 cum	1½ Q.	Aug.,1907
Otis Elevator Co.	20	50	—30	15 0		1½ S. A	Oct., 1907
Otis Elevator Co. pr.	68	96	—28	8.8	6 n. c.	1½ Q.	Oct,, 1907
Penn. Steel	57	.....	.....	.....	.....	.....	.....
Penn. Steel pr	82	104	—22	8.5	7 n. c.	3½ S. A.	Nov ,1907
Pittsburg Coal Co	8	17	— 9	.....	.....	.....	Nov., 1906
Pittsburg Coal pr.	42¾	58¼	—15½	.....	7 c.	3½	Apr , 1905
Pressed Stl. Car	18⅛	53⅜	35⅛	.....		3	Aug., 1904
Pressed Stl. Car pr.	67	99	—32	10 4	7 n. c.	1¾ Q.	Nov., 1907
Pullman	146	180	—34	5 5	8	2 Q.	Nov., 1907
Railway Stl. Spring	26	53	—27	15 4	4	2 S. A.	Oct., 1907
Railway Stl. Spring pr.	77	98½	—21½	9 0	7 cum	1¾ Q.	Sept.,1907
Rep. Iron & Steel	16¼	38⅞	—22⅝	.....	.....	.....	.....
Rep. Iron & Steel pr.	66	96¾	—30¾	10 6	7 cum	1¾ Q.	Oct., 1907
Sloss-Sheffield	35	74	—39	14 3	5	1¼ Q.	July, 1907
Sloss-Sheffield pr.	80	105	—25	8 7	7 n. c.	1¾ Q.	Oct., 1907
U. S. Pipe & Fdy.	20½	46½	—26½	19 5	4	1 Q.	Sept.,1907
U. S. Pipe & Fdy. pr	56	85	—29	12.5	7 n. c.	1¾ Q.	Sept. 1907
U. S. Steel	26⅝	48	—21⅜	7 5	2 n. c.	½ Q.	Sept ,1907
U. S. Steel pr.	87¾	104½	—16¾	7 9	7 cum	1¾ Q.	Nov., 1907
U. S. Steel 5's.	84⅞	97⅜	—12½	5.9	5	5 A.	.....
Va. Iron, Coal & Coke.	38	79½	—41½	.....	.....	.....	.....
Westinghouse Elec.	42	151	—109	23.8	10	2½ Q.	Oct., 1907
Westinghouse Air Brake	133	157	—24	12 0		5 Q.	Oct., 1907

Par value of shares, $100, except those starred (*), $50.

The investment values offered in industrial securities in their present position is shown by the table, the percentage of return being computed upon the rate of dividends actually being paid upon the various issues at the present time. This column tends to emphasize the extraordinary basis upon which the business of the country is being conducted at the present moment.

THE NEW BLAST FURNACE OF THE SHENANGO FURNACE CO. AT SHARPSVILLE, PA.

The Shenango Furnace Co., of Pittsburg, has under construction a new blast furnace at its plant at Sharpsville, Pa. This furnace is now practically completed, and but for the necessity to curtail production would of between 300 and 400 tons per day. Plans formulated, when the erection of this stack was decided on, provided for the erection of two stacks, duplicates of each other, and arranged with their stoves in a straight line, and by different companies with small regard to future extensions. When the various operating companies were combined into the Shenango Furnace Co., the matter of convenient operation and extension became one of ex-

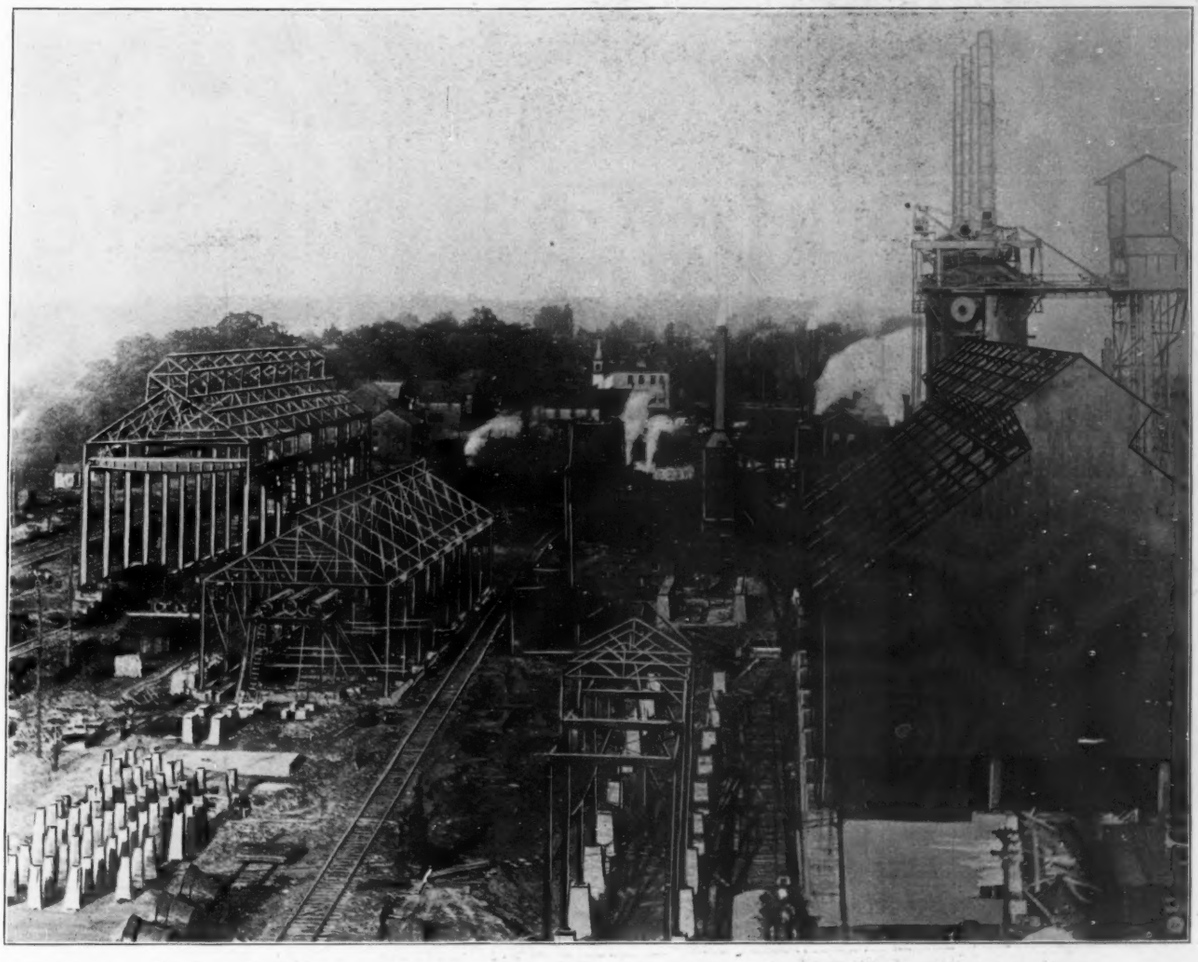


FIG. 1—GENERAL VIEW OF NEW FURNACE PLANT OF SHENANGO FURNACE CO. UNDER CONSTRUCTION AT SHARPSVILLE.

p obably have been blown in on Jan. 1. We present herewith illustrat ons showing progress in the construction of this stack, together with drawings giving its interesting features of which the furnace has a number.

The stack has a height of 80 feet, a diameter at the bosh of 20 feet and a hearth diameter of 12 feet 6 inches, and is supposed to have a capacity the stacks being on either extremity w th the stoves in between. The second furnace will be erected some time in the future, and one of the present older stacks now in operation will be demolished.

The erection of the furnace under discussion was attended with many difficulties, inasmuch as the company had four furnaces in operation which were erected at different times treme difficulty. The new furnace had to be built without interfering with the operation of the existing furnaces to any greater extent than was absolutely necessary. The problem was further complicated by the fact that two main line railroads run through the furnace company's property and divide the furnaces into several groups.

The furnace as at present erected is

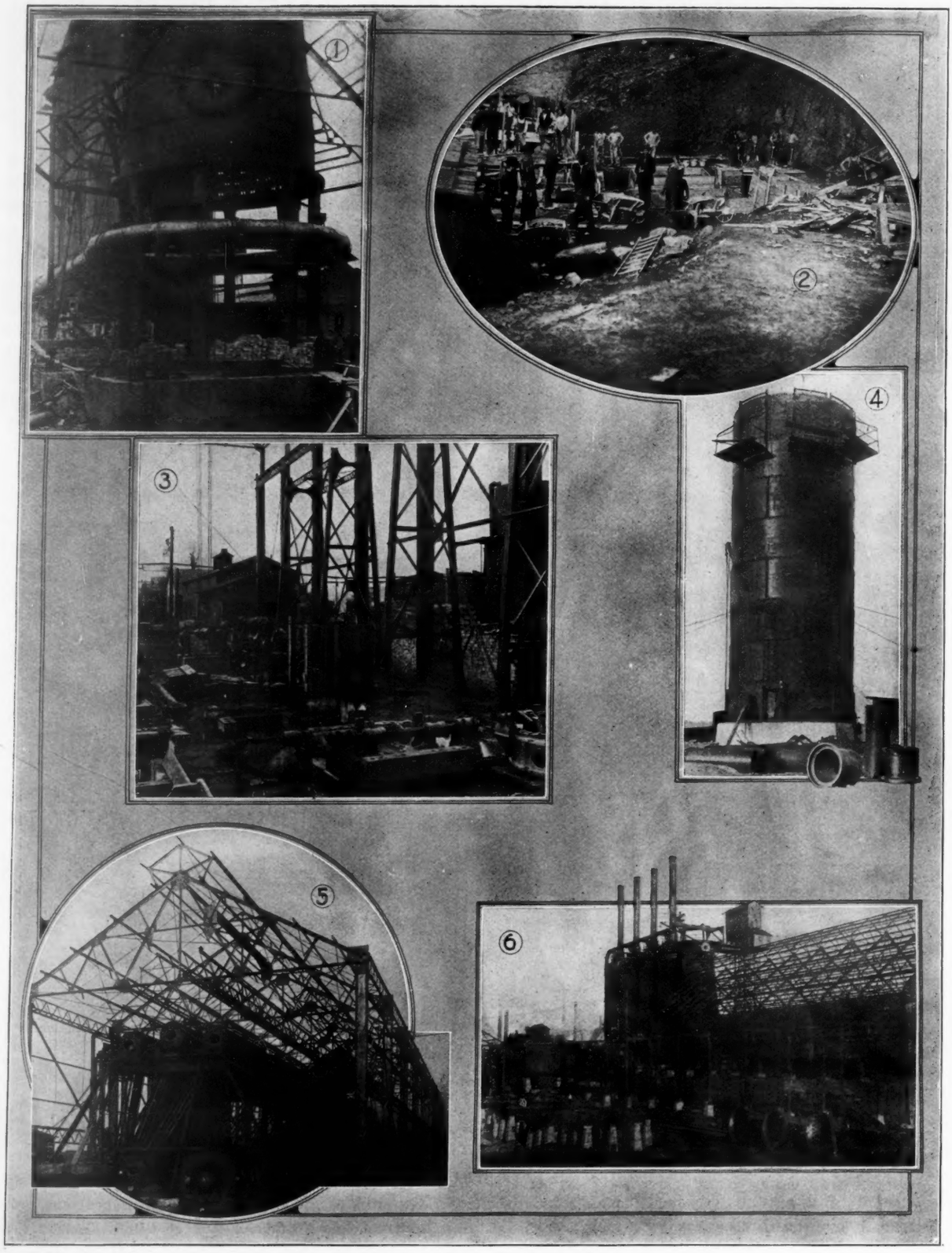


FIG. 2—CONSTRUCTION VIEWS AT SHENANGO FURNACE.

1—BLAST FURNACE BEFORE BRICKING.
2.—FOUNDATIONS FOR PUMP HOUSE.
3.—START OF ENGINE HOUSE.
4.—STANDPIPE, EIGHT OF NINETEEN RINGS ERECTED.
5.—BOILER HOUSE BEFORE ENCLOSING.
6.—CAST HOUSE BEFORE PLACING ROOF.

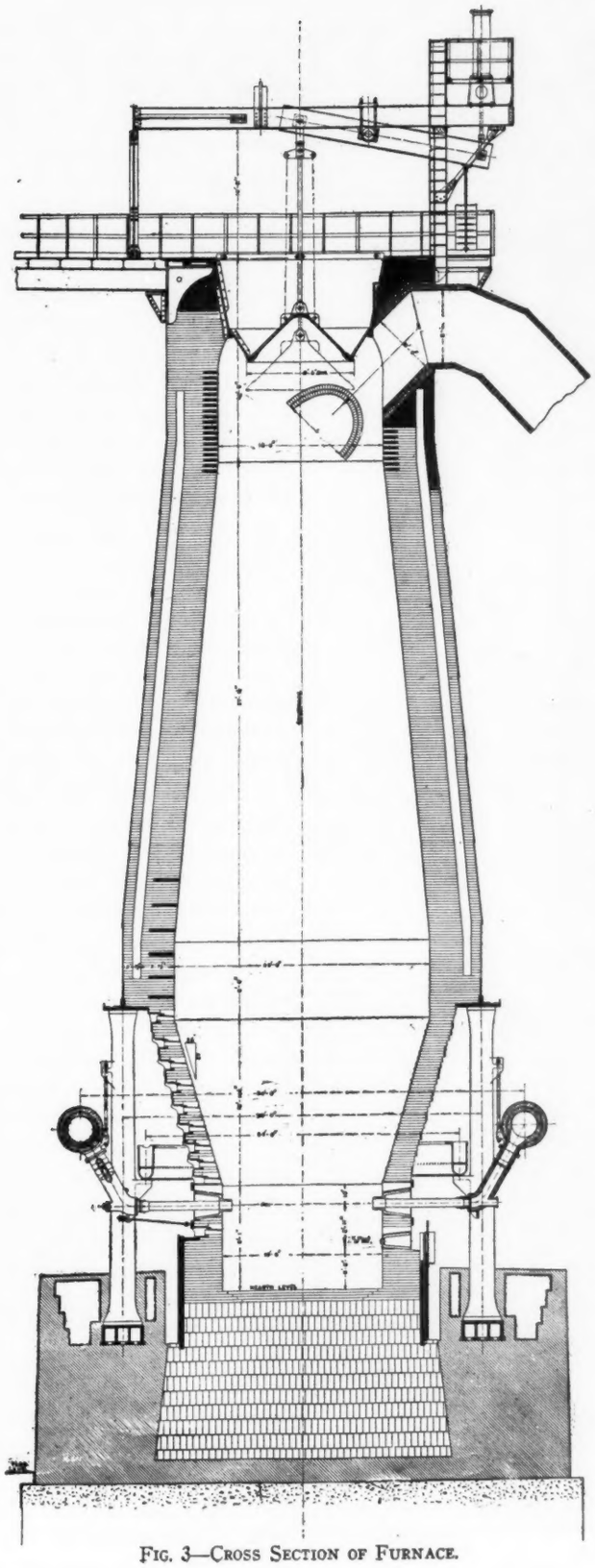


FIG. 3—CROSS SECTION OF FURNACE.

a hand filled stack, this condition being rendered necessary by the layout of the yard and the desirability of keeping the other furnaces in operation, as the installation of a skip hoist would necessitate the removal of one of the older stacks. The plans of the furnace have been so drawn, however, that ultimately a skip hoist may be installed. Another factor involved in the adoption of the hand filled stack is that the output of this company is used in such a manner as to require iron that runs very close to a given analysis, and that, due to this fact, great care must be exercised in charging to insure even distribution in the stack. It is generally conceded that the distribution can be better controlled and made more uniform with hand filling than with the skip hoist, although at a possible sacrifice of capacity. The hoist for the furnace comprises a double lift with platforms 8 feet 6 inches by 8 feet in the clear operated by an Otis Elevator Co. 12 x 12-inch direct geared hoist engine.

One of the most interesting features about the furnace is the arrangement of the top. But a single bell is used operated by a steam cylinder controlled by the top man. The steam cylinder is clearly shown at the top of the section of the furnace, Fig. 3, and is unusual in that it is inverted from the usual position, the steam pressure, when the bell is closed, being on the piston, which is down, thereby obviating any wear or leakage in the stuffing box. Arrangements have been made whereby the top is tight and all excessive quantities of gas, due to slips or explosions, are handled by the downcomers, and no ore, coke or other material can be thrown out into the air.

The design of downcomers is unusual and demands attention. Contrary to the usual arrangement, there are no bleeders or explosion doors on the furnace proper. Three downcomers are used instead of two, as is the usual practice, the combined area of these three being about 50 per cent larger than the area usually provided. The center downcomer is 5 feet 9 inches inside diameter and is taken off

from the side of the furnace directly facing the dust catcher. Ninety degrees away from the main downcomer pipes the auxiliary downcomers of the same diameter are led to the dust catcher. The dust catcher is of un-

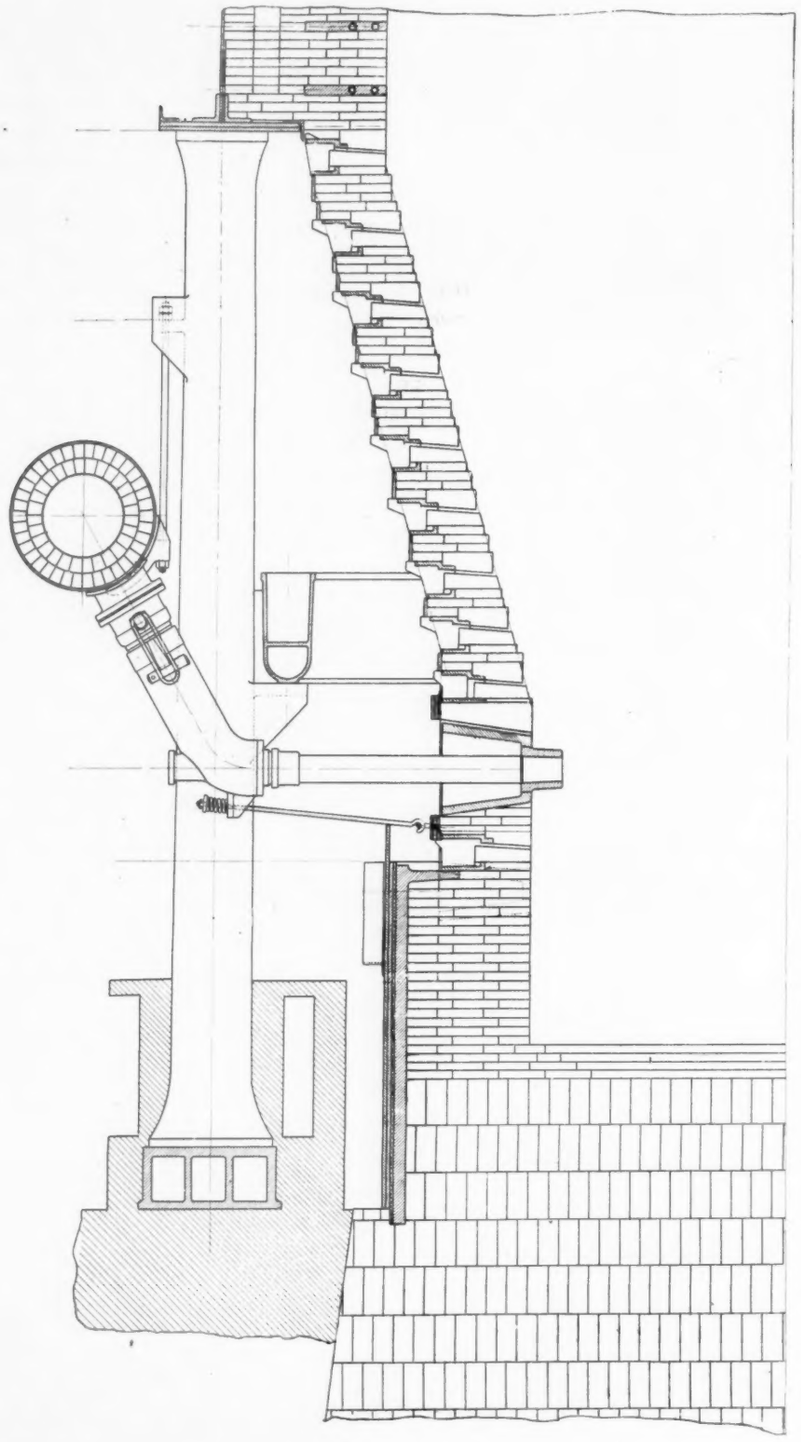


FIG. 4—BOSH CONSTRUCTION OF FURNACE.

usually large size, 24 feet diameter by 28 feet in height in the body with a chimney 6 feet 9 inches, extending 51 feet from the top of the dust catcher and projecting 17 feet above the top of the furnace platform. An explosion bell is placed on top of the chimney. Near the top of this chimney another pipe, 3 feet 6 inches inside diameter is led off, this acting as a bleeder. The dust catcher contains no baffles or interior obstruction of any sort, the idea being that the force of all explosions and slips should be dissipated in it as much as possible and the gas freed from dust. It is due to this desire to minimize the effect of explosions that the dust catcher is made unusually large.

The illustration, Fig. 4, shows the bosh construction of the furnace. Smeeth bosh plates are used, any one of which can be withdrawn, as required. The bosh hands are composed of 1-inch x 5-inch flats and are 14 in number. The mantle is built up of plates and angles carried on cast iron columns.

In connection with the dust catcher, a gas washer has been installed of the Shenango type, which is the invention of Frank Pettit. This washer is shown in the drawings, Fig. 8, a plan, sectional elevation and half end section and elevation being presented. The path of the gas is clearly shown by the arrows, it entering through two vertical pipes and passing through the four chambers, as shown. The two central chambers contain baffle plates, which are approximately semi-circular in section, whose function is to cause the gas to impinge sharply on the surface of the water and deposit the dust thereon. The baffle plates do not dip under the surface of the water, but permit a small amount of gas to pass under their edges and up into the next chamber. The interesting feature of this washer and the one on which the inventor lays special stress, is the fact that it is self-cleaning. Water enters the body of the washer through an apron plate, and is removed through the overflow pipe on the interior, a water seal preventing any of the gas from flowing out with the water. The overflow pipe is situated so as to be just below the surface of the water in the washer and all water flowing into the pipe is surface water. As the scum and

on either side of the furnace two short pipes are led out at right angles to the furnace, each 4 feet 9 inches inside diameter. From these

dust from the gases are on the surface, these are removed with the water.

The water discharged from the washer, together with the dust, is carried to a cinder pit, a section of which is shown in the illustration,

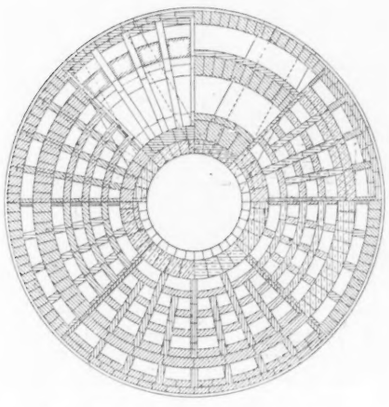


FIG. 5—CROSS SECTION OF STOVES.

Fig. 9. This cinder pit is built in two parts, one circular and the other elliptical in plan. The small circular pit is used for the discharge from the gas washer and dust catcher, while the larger elliptical pit is used for furnace slag, which is granulated as it flows into the pit. The cinder

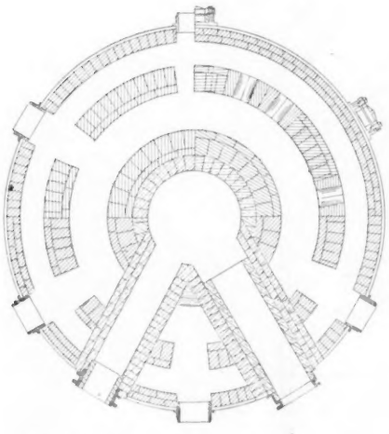


FIG. 6—CROSS SECTION OF STOVES.

is removed from the pits by means of a Browning Engineering Co.'s slag handling apparatus traveling on a runway 252 feet long. A spur track is laid under this runway on which a considerable number of cars can be stationed, thereby making it unneces-

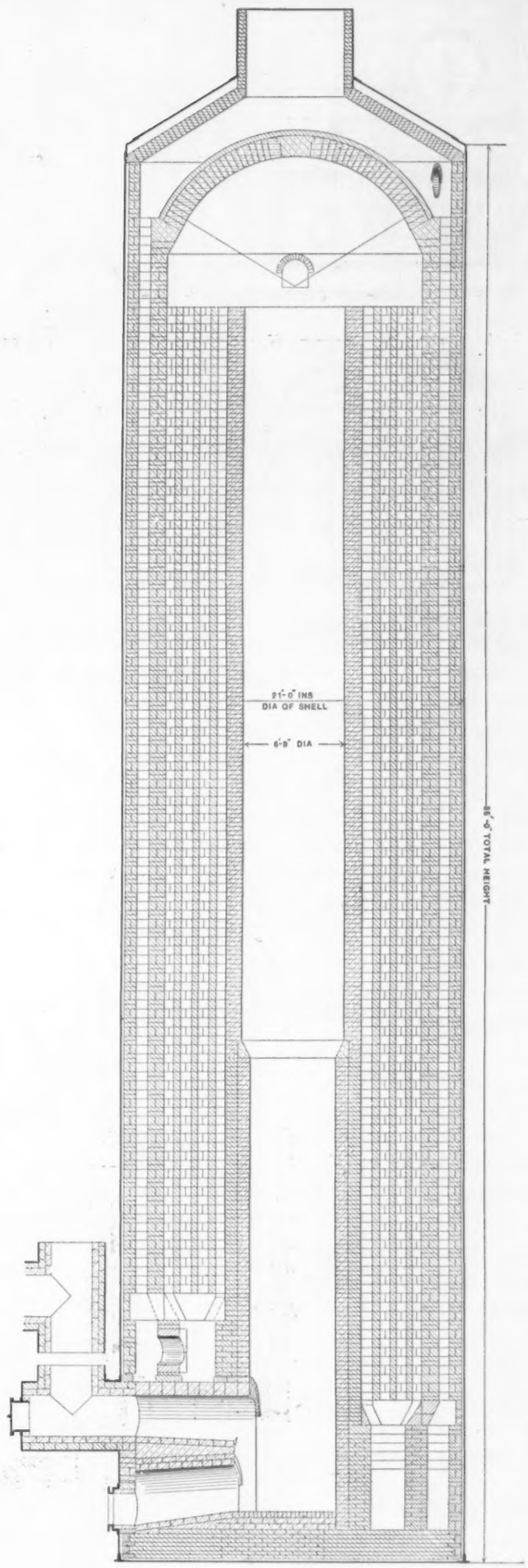


FIG. 7—SECTIONAL ELEVATION OF STOVES.

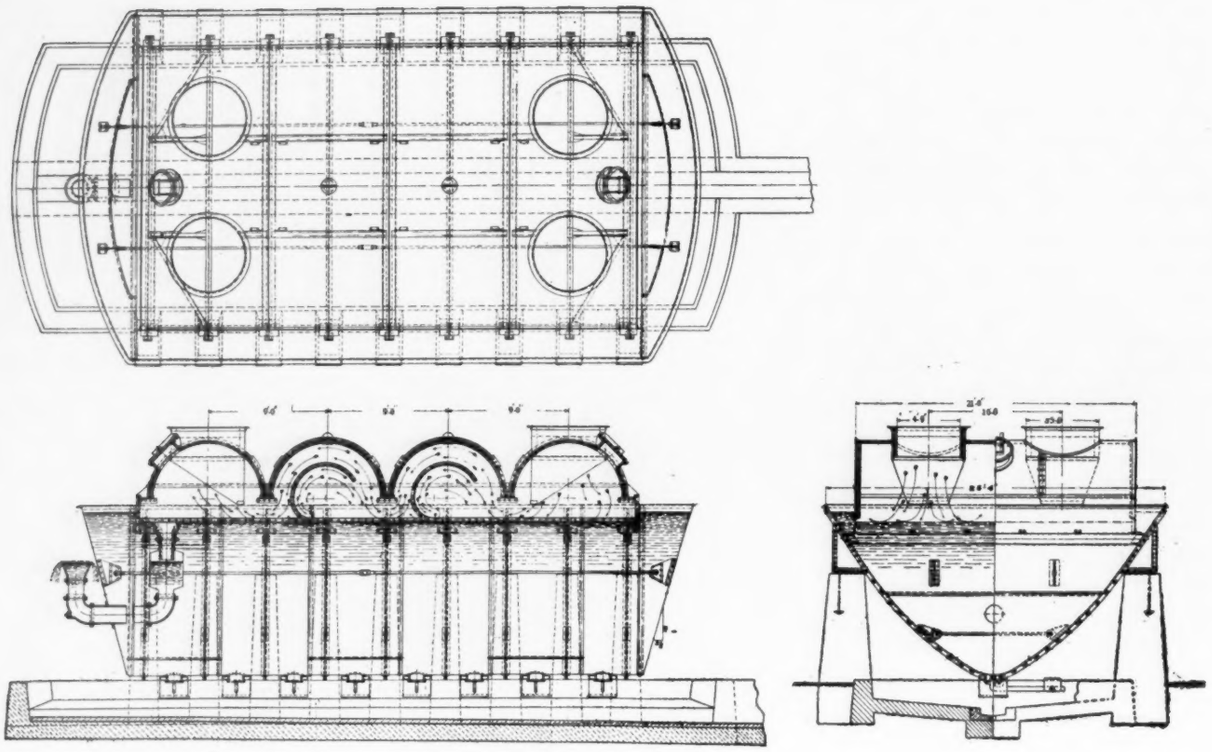


FIG. 8—THE SHENANGO GAS WASHER.

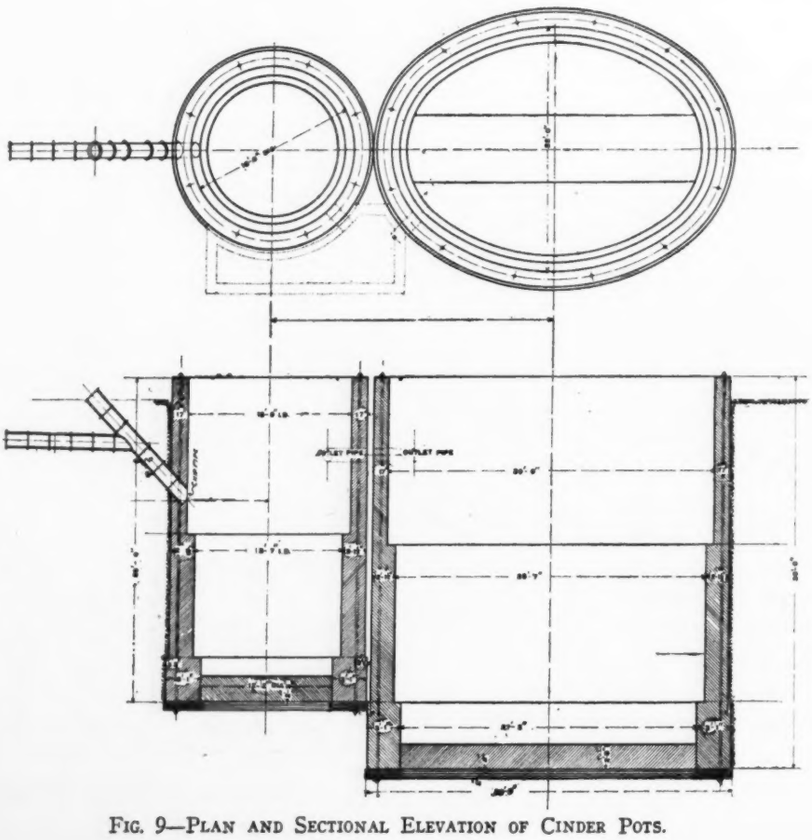


FIG. 9—PLAN AND SECTIONAL ELEVATION OF CINDER POTS.

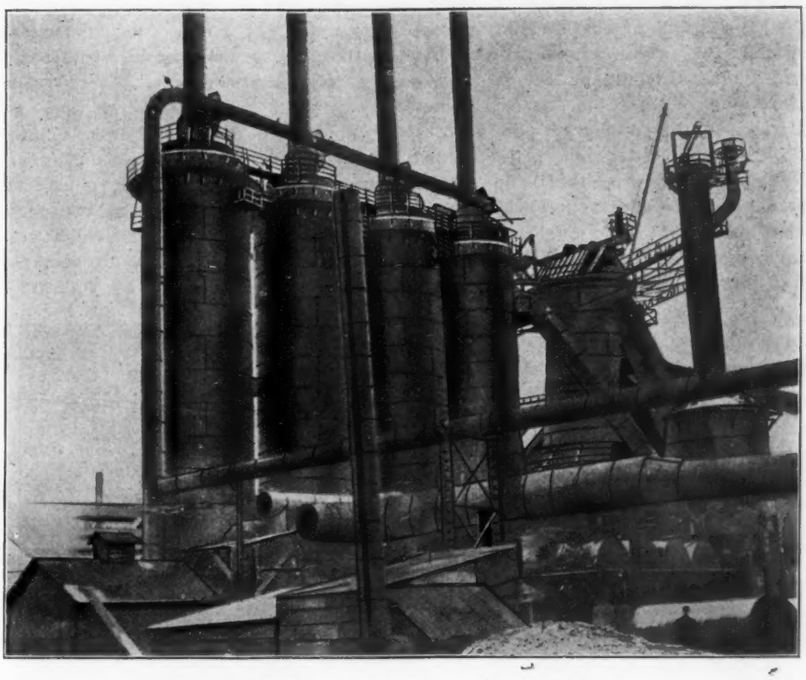


FIG. 10—GENERAL VIEW OF FURNACE AND STOVES.

sary to remove loaded cars oftener than once a day.

The furnace is equipped with four McClure stoves of the three-pass type. These stoves are each 21 feet inside diameter by 85 feet in height. Each stove is surmounted by a stack 56 inches inside diameter.

The cast house, 197 feet x 77 feet, is a steel frame and corrugated iron structure with an asbestos roof. This latter was put in with the expectation that it would not be injured in any manner by the fumes always present around a furnace plant and which have such injurious effects on metal roofs. Ordinarily, the product of the furnace is taken direct in hot metal cars for use in other industries in the vicinity, the hot metal track running just outside one wall of the cast house. A Uehling two-strand pig machine, however, is installed some distance away from the furnace for use when the hot metal is not required.

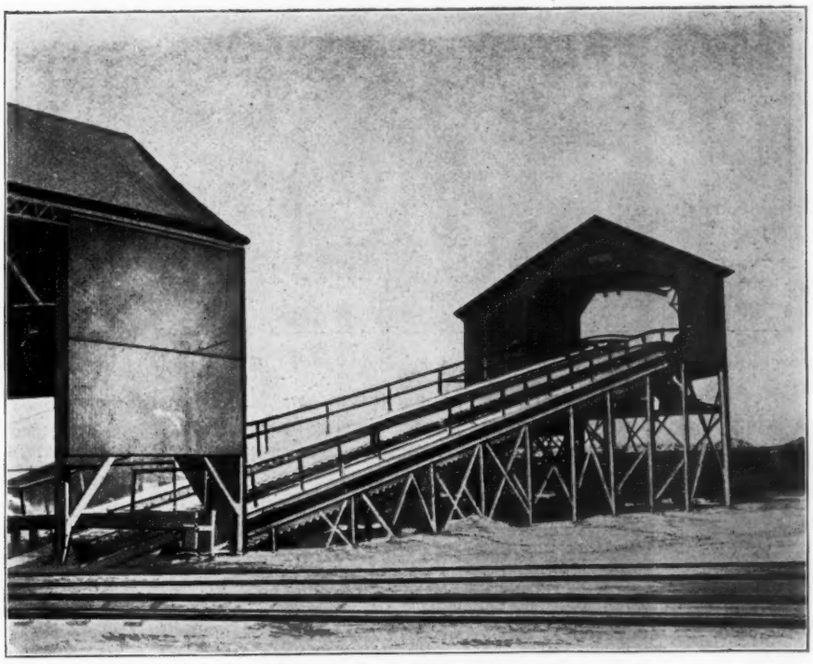


FIG. 11—PIG CASTING MACHINE.

The boiler house is a steel frame and corrugated iron structure 326 feet 6 inches long by 43 feet 6 inches wide. In it are installed seven 430-horsepower Stirling boilers, each boiler being an independent battery. Directly opposite the center line of the furnace a space has been left in the boiler house for the installation of a hoist engine, when the furnace is changed from a hand filled to a skip filled stack. Each boiler is provided with an independent steel stack, 54 inches diameter by 100 feet high. These stacks are guyed direct to the boiler house.

The engine house, of steel frame and brick wall, is situated beyond the boiler house and is 180 feet long by 48 feet wide. It contains three Allis-Chalmers blowing engines of the simple non-condensing vertical, long cross-head type. The cylinder dimension are 44 and 84 x 60 inches stroke. Simple non-condensing engines were adopted for a number of reasons, one of the foremost being the desire to avoid any unnecessary complication of machinery. A strong reason for the omission of a condensing plant is the fact that the furnace yard level is about 100 feet higher than the mean water level of the Shenango river from which the water supply is obtained, and the cost of pumping this water would more than overbalance the saving due to condensing. The pump house, which is situated on the river bank some distance away from the furnace, is 35 x 43 feet in dimensions and contains three Epping-Carpenter duplex-compound direct-acting plunger pumps, each of 3,000,000-gallons capacity. The cylinder dimensions of these pumps are 14 and 25-inch steam cylinders and a 60-inch plunger by 24 inches stroke. In connection with the water supply system, a We-fu-go water softening plant has been installed. This is of 8,000-horsepower capacity, but has been designed to soften water for all five furnaces of the plant. A stand pipe 20 feet diam-

eter by 110 feet high has also been erected.

Owing to the congested yard arrangements, due to the location of the older furnaces, no stockhouse has been erected for the new furnace. The ore and coke buggies are filled at the ore yard and stockhouse of the older furnaces. Ultimately, however, when the second furnace is built, a complete and modern stockhouse will be erected.

W. O. Barrows is general superintendent of the plant and Frank Pettit, mechanical engineer.

WIRE ANNEALING PLANT.

A continuous annealing furnace and soaking pit, designed for the uniformly soft annealing of steel wire, has been installed at the plant of the Capewell Horse Nail Co., Hartford, Conn., by the Kenworthy Engineering Co., of Waterbury, Conn. This installation replaces an old type of annealing furnace the operation of which necessitated the removal of the wire while at a red heat and its transmission in this condition about 60 feet through the open air to the soaking pit, thus unevenly cooling and unnecessarily scaling the metal.

The furnace proper, at the Capewell plant, is about 50 feet in length and 12 feet in width through the fire boxes, dropping to 9 feet in width through the heating chamber. It is constructed of refractory brick, with red brick on the outside, secured by I-beam ties and having cast iron front, firing plates, etc. It is arranged for the use of solid fuel, anthracite in this particular case, though, with little variation in design, oil, coal or gas can be utilized.

The wire to be treated is fed into the furnace by means of a hydraulic charging elevator and is deposited in bundle form on two parallel water-cooled skid pipes running the entire length of the furnace. The bundles are propelled along these pipes by a hydraulic puller located at the discharge end. A ratchet arrangement is employed, dogs engaging with the inside of the coils of wire during the forward movement and dropping down below the skid pipes for the return trip. Near the discharge end of the furnace is provided a series of six flues leading out of either side of the heating chamber and connecting with the stack. The top of the furnace throughout its length is of arched design and is sufficiently high to admit of the wire being handled two or even three bundles deep.

In the designing of this furnace, an unusual difficulty was met in the fact that the limits of the building necessitated two right-angled turns. As will be seen from the accompanying plan, one of these is located immediately at the discharge end and is slightly rounded, upright roller guides being provided on either side of the passageway to direct the heated bundles around the turn onto an inclined roller skid. From this the wire is transferred directly to a horizontal conveyor running through a concrete soaking pit, which is depressed to the level of the mill floor. This soaking pit runs about 85 feet in one direction and then, shortly before the end, makes another 90-degree turn by means of a fan-shaped roller skid. This leads to another wire conveyor which is inclined so that the bundles, now cold, are delivered at any desired height.

A conspicuous advantage of this furnace is, of course, its continuous feature; the heating furnace and soaking pit being connected, there is no exposure of the wire to the open air at any stage of the process, a thoroughly uniform soft annealing is assured and, except where a special finish is sought, no further heating is required. The ease with which corners are turned is also of importance in that it admits of installations within comparatively narrow limits. Through the depression of the soaking pit to the floor level, a remarkable economy of floor space is secured. Both the hydraulic elevator for feeding the furnace and the inclined conveyor for delivering the annealed wire are features of convenience, and the water-cooling of the skid pipes on which the bundles travel affords a satisfactory solution of a perplexing problem.

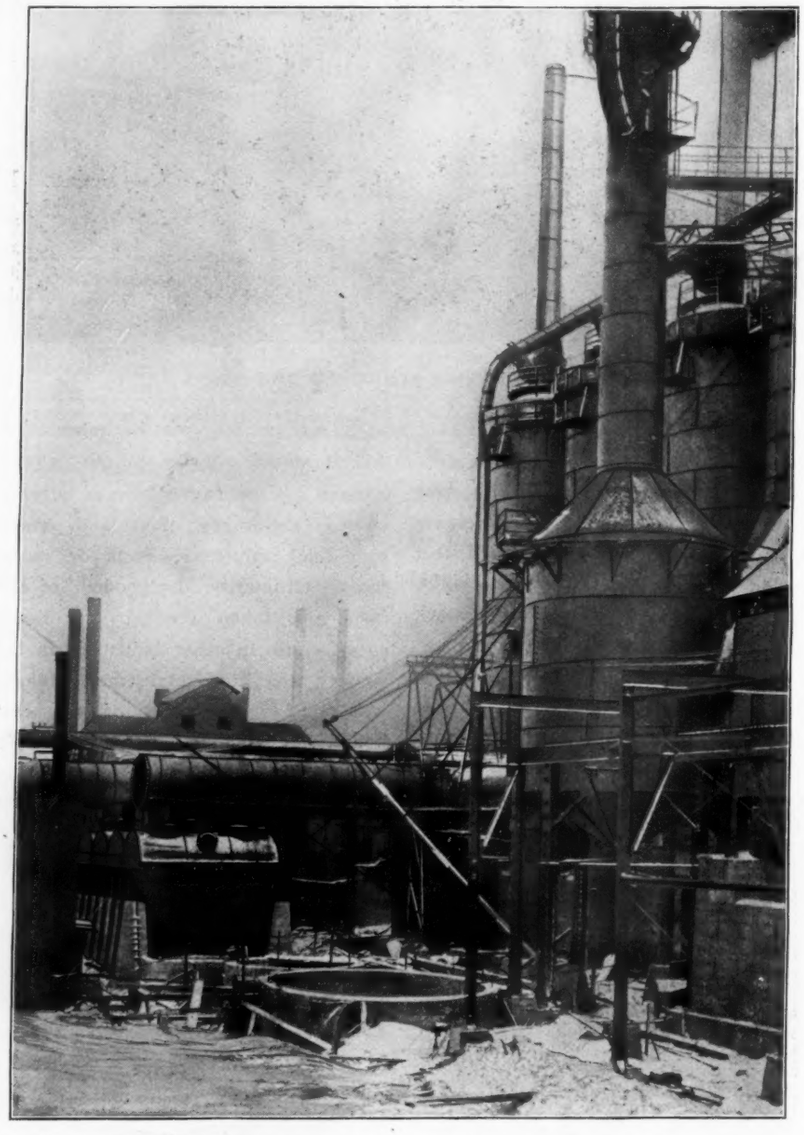


FIG. 12—DUST CATCHER, STOVES AND GAS WASHER, SHENANGO FURNACE.

THE USE OF BLAST FURNACE AND COKE OVEN GAS

By F. E. Junge.[1]

The managers of American iron and steel works are beginning to take note of the fact that a certain economic phase of their business has been neglected. The escape into the atmosphere of a large portion of the gases generated in the operation of a blast furnace or coke oven, represents the waste of a commodity with a value in dollars and cents. Foreign managers, and especially those in Germany, recognized this fact long ago, and took steps to utilize these so-called waste products. Mr. Junge presents here the results of an investigation, on the ground, of the latest developments along this line in Germany, and his observations and conclusions should be carefully considered by works managers and engineers having in mind the most economical and efficient operation of their plants.—Editor.

An innovation or improvement in the mechanical equipment of iron and steel works, which will save the producers—with an annual output of 24 million tons—at least $16,000,000 per year, or 60 cents and more per ton of pig iron made, is certain of serious consideration by thoughtful men. Such an innovation is the application of gas instead of steam power for driving blowing engines, pumps, lifts, etc., and for generating electric current in blast furnace plants, rolling mills and other departments of large combined works.

Leaving out of consideration the share, which modern by-product coke ovens, in large plants, contribute to the process of steel making we must distinguish between three separate conditions: 1. The available blast furnace gases are not sufficient to render the blowing work and to heat the blast, so that additional power or heat must be introduced into the plant in the form of coal. 2. The available blast furnace gases give sufficient power and heat to cover all requirements at the furnaces. 3. The available blast furnace gases yield, in addition to the above, a surplus which can be used for other purposes within and outside the plant. The first two cases have been entirely overcome in continental iron smelting plants, while we find such waste going on in some countries, whose iron industries have not yet been reformed to modern economic standards. So the third case is really the one which is still deserving the attention of progressive iron masters at the present time.

It is a simple matter of calculation to prove that the blowing work in iron and steel plants represents a rather insignificant amount compared with the total amount of gas available from blast furnaces, and even compared with the surplus gas which remains available after deducting all requirements for the furnace proper. Hence improvements in the blowing service alone will not bring about any sweeping economies in the balance sheet of the process. It will be remembered that of the total quantity of gas produced, about 45 per cent is absorbed by the hot blast stoves, and by charging and other losses, while about 15 per cent is required for motive power purposes at the furnaces, including blowing engines, hoists, pumps, etc., leaving 40 per cent for other uses.

The role which the blowing service plays in the process of conversion of coke and ore into pig iron will be readily understood from the following calculation: A. Nagel, of Dresden, Germany, after an exhaustive investigation in various iron smelting plants, gives the average analysis of blast furnace gas—deducting the contents of steam and water vapor—in per cent of volume:

Carbon	29 per cent
Hydrogen	3 per cent
Carbon dioxide	8 per cent
Nitrogen	60 per cent

Reduced to the normal condition of atmospheric pressure at 15 degrees Cent., a gas of this composition possesses a (lower) heat value of 884, or in round numbers 900 calories per cubic meter, or 100 B. T. U. per cubic foot. From the amount of carbon contained in the blast furnace gas it is seen that per ton of coke, or ore, charged to the furnace, about 4,300 cubic meters of gas are produced. From the nitrogen contents of the gas it is found that 3,300 cubic meters of air must be introduced into the process as hot blast and are required for supporting combustion.

Assuming an efficiency of the hot blast stoves of 60 per cent, the heating of 3,300 cubic meters of air up to 700 degrees Cent. requires the burning of 1,300 cubic meters of blast furnace gas, so that for every ton of iron produced a remainder of 3,000 cubic meters of gas is still available. From this amount the blowing engines must be driven and any surplus that may remain can be used for other purposes within and outside the works. Taking the total mechanical efficiency of gas or steam blowing engines as 0.65, the compression of 3,300 cubic meters of air per hour requires the expenditure of about 100 indicated horsepower, which corresponds to the production of one ton of pig per hour. This blowing work can either be produced by steam power or by gas power. In the first case (steam engines or turbine blowers), we have —assuming as high as 13 per cent total thermal efficiency including boilers—to expend at least 540 cubic meters of blast furnace gas, per ton of iron. In the second case (gas blowing engines) the amount of gas needed for the same effect is never higher than 220 cubic meters. Hence there remains per ton of iron made 2,500 cubic meters of gas when using steam power, and 2,800 cubic meters when using gas power.

The above result, though based on an output of one ton of pig iron per hour, remains the same, relatively speaking, for any size of plant and proves that improvements affecting only the blowing department alone would not increase the productive efficiency and economy of iron industries to such an extent as to warrant a radical departure from the convential methods, and to justify the augmentation of complexities and the provision of skilled labor for attendance, which is always a more or less difficult and expensive undertaking in a country like the United States. On the other hand, since the hot blast stoves consume by far the largest quantity of gas produced, it is evident that their correct design and construction is of the greatest importance to the gas economy of the plant. Another, no less serious question is this: What method must we adopt in using the remaining surplus of about two-thirds of the total quantity of available gas, in order to gain the maximum useful power out of it? This power is to be used chiefly for driving electric generators in a central station, whence current is distributed for operating scattered machinery all over the works, while the remaining surplus is sold to neighboring markets at a profit.

[1]Consulting engineer, 150 Nassau street, New York.

Gas Power Available.

It was said that the quantity of gas available for generating motive power beyond what is required at the furnaces proper is about 40 per cent of total amount of gas produced. One ton of coke, containing 15 per cent of water and ash, charged to the furnace together with the ore for smelting the latter, will generate from 4,300 to 4,500 cubic meters of gas. Hence there are 1,800 cubic meters of, say, 950 calories, or an average of 1,700,000 calories available for producing motive power. This power, it was said, may either be produced in steam engines or turbines or it may be developed by direct combustion of the cleaned gases in large gas engines. In these engines the heat required to generate one kilowatt is between 2,500 and 3,500 calories. In steam turbines the consumption is between 7,600 and 8,900 calories. By adopting gas power instead of steam power we can therefore realize from two to three times more electric current from the surplus gas. This holds true when the hot blast stoves are heated directly by furnace gas. If special producers burning inferior grades of coal, mine culm and other waste, are installed for furnishing a gas of higher calorific value to the hot blast stoves (at no added heat cost) then the power output from blast furnace gas can be still further increased, and the superiority of gas engines over steam turbines becomes even more pronounced. For conditions as prevail at present it can be taken that the power which becomes available by the adoption of gas engine is 30 effective horsepower per ton of pig iron produced. Or roughly speaking: The actual available gas power in horsepower-hours which can be harnessed from a blast furnace plant beyond what is required for the smelting process proper is equal to the number of tons of pig iron turned out per month. A furnace, having an output of 100 tons a day or 3,000 tons per month, will yield a continuous surplus of 3,000 horsepower every hour, acting precisely like a gas producer of 3,000 horsepower capacity.

Now coming to the conversion of this surplus gas power into electrical energy, which is by far the best method of utilization to adopt notwithstanding the various transformation losses—for almost all departments in large combined plants can now be operated by electric motors from a central station—it is evident that the self-cost of motive power production from blast furnaces is composed of the following items: 1. Direct operating expenditures. 2. Amortization of the plant. 3. The coefficient of utilization. Item 1, in turn, comprises wages, lubrication, gas cleaning, current maintenance and repairs.

Item 2 embraces the sinking fund charges, including cost of plant installation, operative life of materials used, and interest on the capital tied up. The amount and distribution of these items vary, of course, in different localities. So does the value of the utilization coefficient, which is the ratio between power available and power used. In those departments which run day and night without

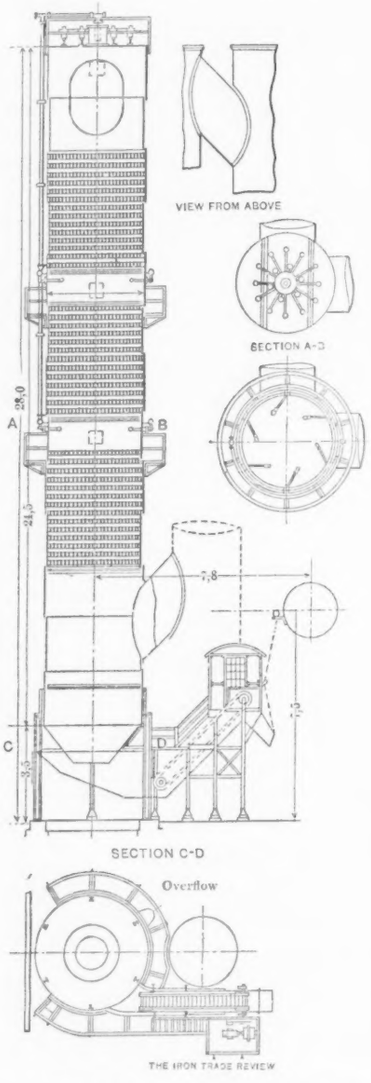


FIG. 1—GAS CLEANING PLANT WITH STATIONARY SCRUBBING TOWER.

interruption, like blowing engines, the coefficient may be as high as 90 per cent. In rolling mills it may run as high as 70 per cent, where again other applications offer only as low as 35 per cent outlet to the available power. Therefore, the more central station business, with stable outside customers, for the distribution of the surplus current can be developed by the plants management, the higher will be the remunerative returns realized from the power end of the blast furnace plant.

Gas Power vs. Steam Power in Belgium.

The above generally known statements may be substantiated by a few data which L. Greiner reports as the result of the adoption of gas power instead of steam power, obtained in the Cockerill Works, Belgium. These works possess two central electric stations with a combined capacity of 8,000 electrical horsepower, of which 5,000 kilowatts are derived from blast furnace and 800 kilowatts from coke oven gases. Current is supplied to 600 electric motors of all sizes. Item 1, operating expenditures, or net cost of one kilowatt-hour, comes out as 0.65 centime or 0.13 cent, of which amount 45 per cent must be credited to wages, 20 per cent to lubrication and 35 per cent to maintenance and repairs. Item 2, sinking fund charges, are figured at 400 francs or $80 per kilowatt installed, divided up as follows: Gas engines, 45 per cent; dynamos, 15 per cent; buildings, 15 per cent; foundations, 5 per cent; gas mains and cleaning apparatus, 15 per cent; pumping machinery and water mains, 5 per cent. Making the (liberal) assumption that the entire plant would be obsolete in 10 years, then the annual value sunk would correspond to 13 per cent of the capital involved, and this bringing interest at 5 per cent, would amount to 52 francs or $10.40. Assuming further that the utilization coefficient of the plant is 50 per cent, the distribution of the various items works out as follows: Net cost of operation, 0.13; sinking fund, 0.23, total cost, 0.36 cent per kilowatt-hour. When the utilization coefficient increases to 75 per cent the cost decreases to 0.08, 0.16, 0.25 cent, respectively. When it would rise to 100 per cent, which, of course, is only a theoretical assumption, the distribution of cost on the different items would be 0.06, 0.12 and 0.18 cent per kilowatt-hour, respectively.

This calculation is made under the assumption that the available blast furnace gases have no value whatsoever. In German practice—and this question is of great importance when making up the balance sheet of the plant—it is customary to appraise these gases according to some standard which depends on and varies with the local conditions prevailing in the neighborhood of the works. It may be of interest, therefore, to complete the foregoing investigation by some data which the writer has ascertained during his sojourn in Germany, the past summer. The following calculations are built on German material and labor prices, but they are, therefore, no

less interesting to Americans of the class to which this contribution is purported to appeal: men that plan and exploit industrial enterprises. For permanence and stability in this and all industries can be attained only by adjusting native industrial policies to those that have rendered possible continuous economic success abroad, where, owing to scarcity of natural resources, density of population, and the necessity to conquer foreign markets, people were driven to face earlier the problems, which are beginning to confront this country now—with a population rapidly increasing while resources are decreasing—namely, the preservation of national supplies and the economic production of superior goods which can compete successfully on the world's markets.

Cost of Equipment and Operation of a 3,600-Horsepower Blast Furnace Gas Engine.

The engine under discussion is of the double-acting, twin-tandem type, Nürnberg construction, which has served as a model to all European and American builders. In most cases it would, of course, be advisable to install two separate units of 2,000 horsepower each, instead of a twin engine, since this will double the reliability of the plant.

Cost of Equipment.

The price of the complete engine with compressed air starting equipment, barring-over device, with exhaust barrel and pipings but without fly wheel, all made and erected in Germany, is about $80,000, or $22.85 per horsepower, (against $35 to $45 in this country). Assuming an annual amortization of 12 per cent of the book value of the engine and figuring out the average for the first five years, it is found that this will amount to about 9.5 per cent of the initial cost. Hence there is $7,560 to be set back for this purpose. The engine foundation requires about 4,590 cubic feet, at about $5.35, giving a total of $6,800. This amount may be amortizated each year at a rate of 5 per cent of its book value, which gives for each of the first five years an average amortization of 4.5 per cent of the initial cost or $307. Hence, for the complete engine plant $7,860 is to be set back annually for depreciation purposes. Figuring on 4 per cent interest on the total initial capital of $86,570, the sum of $3,460 is obtained.

Cost of Operation.

As regards lubricating materials and waste it is a matter of experience that in 24 hours about 130 pounds of oil, costing about 3.2 cents per pound, and in addition for grease and waste $1.00, that is a total of $5.25 is required for an engine of that size and type. The cost for repairs depends, among other things, on local conditions, and on the kind of treatment which the engine is receiving, but it may be assumed, as a matter of experience, that the cost for spare parts together with the wages required for repairing do not amount to over $2,140 per annum. In this amount included are expenses for cleaning work, which must be carried out about four times a year. This item depends greatly on the efficiency of the gas cleaning apparatus employed. Theisen washers continue to give best results. For attendance we figure on about 25 cents per operating-hour, since the wages paid to engine attendants are about 10 cents an hour, and for each of the two boy assistants we pay 7 cents per hour.

It is seen that there is a great divergence in prices paid for skilled labor of this class in the United States against what obtains in Germany. Generally speaking wages are about one-third of what they are here. This is taking the average of 12 trades. It is this difference in labor cost which accounts greatly for the reluctant attitude of industrial circles towards the adoption of innovations like gas power, which absolutely requires the training of an efficient force of mechanics to new standards. It also accounts for many other differing traits and policies in the industrial development of the respective countries.

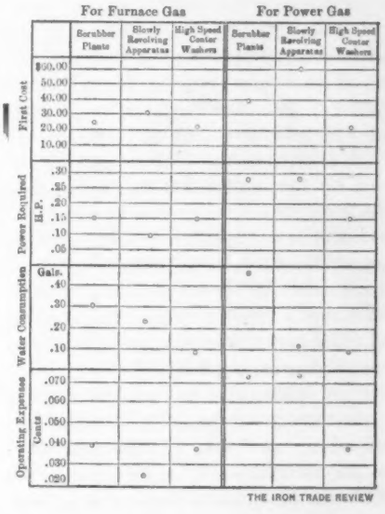
As regards the valuation of the available blast furnace gases we chose of the three methods of appraising the one which compares the heating value of the gases with that of coal. We have in the particular locality in which the prospective plant is to be erected coals of 7,200 calories per kilogram (12,960 B. T. U. per pound), costing $2.10 at the mine. Since a gas engine even when running on medium loads does not usually consume more than 2,500 calories (9,920 B. T. U.) per horsepower-hour, the value of the blast furnace gas consumed per effective horsepower per hour can be taken as 0.074 cent. As a matter of experience these engines are usually 8,000 hours per year in active service.

Table I.—Total Cost of 3,600 Horsepower Gas Engine.
(Cylinder Diameter 1,050 Millimeters) Running on Blast Furnace Gas, Nurnberg Works, Germany.

	For 24 hours.	Per year.	For 8,000 hours.	Per effective horsepower hour.
Amortization of engine (12 per cent) Amortization of foundation (5 per cent) Interest on initial capital (4 per cent)	.....	$11,320	$11,320	0.039 cent
Cost of gas (blast furnace)	.....		21,400	0.074 cent
Lubricating material and waste	$5.25		1,740	0.006 cent
Attendance	5.70		1,900	0.007 cent
Repairs, spare parts, cleaning	.....	2,140	2,140	0.007 cent
Total cost	.....		$38,500	0.133 cent

The expenditures for cooling water differ greatly in different localities. They depend, among other things, on the kind of water supply and on whether or not a back cooling plant is required. In any case the cost of water and cooling plant will be much lower for a gas engine, than it is for a steam engine of the same capacity. In the first instance 66 pounds of cooling water per horsepower-hour will be ample, while for a steam engine having a steam consumption of 15.4 pounds, an average of about 440 pounds is required for condensation. The negative work which is consumed in driving the pump that supplies cooling water to the piston and rod is taken into account in this calculation as internal resistance of the engine, when figuring on its mechanical efficiency, and has been included in the value or price of the gas consumed per effective horsepower-hour, which was determined as 0.074 cent. The following table is transposed from the original German calculation and shows that the total cost for an engine of 3,600 horsepower normal capacity per year is $38,500, or 0.133 cent per effective horsepower-hour.

Table II—Showing Relative Merits of Different Systems of Gas Cleaning Based on 1,000 Cubic Feet Capacity.



Gas Cleaning.

A few words may be added on the question of gas cleaning. It is an acknowledged fact that all the gas which is liberated from the blast furnaces should be cleaned, regardless whether it is used for heating or for power purposes, though for heating blast stoves the degree of purity need not be so high as when the gas is used in gas engines. At Dommeldingen, Germany, the employment of cleaned gas for heating Cowper stoves has effected a reduction of coke consumption, in consequence of the higher temperatures attained, representing an annual saving of $8,600 for one 100-ton oven. Gas engines in order to be able to operate successfully without breakdown must be supplied with gas containing not over one grain of dust per 1,000 cubic feet.

Table II shows the relative merits of the three systems of gas cleaning: Stationary spraying towers, scrubbers and dryers, slowly revolving drum washers, and high speed centrifugal fans (Theisen). With the first named equipment, and taking European material and labor conditions, the cost of a gas cleaning plant per 1,000 cubic feet of gas comes out as follows: Initial capital outlay is $26 for heating gas, and $39 for power gas, not including pipe connections, clearing ponds, water pumps, gas holders and similar accessories, the price of which varies with the local conditions of installation. The consumption of cooling water per hour is 31.2 gallons for heating gas and 46.4 gallons for power gas, the temperature of the water varying from 5 to 35 degrees Cent., according to the season. The cost of operation for plants in use 365 days a year and 24 hours daily, figuring on the horsepower as costing 0.25 cent, and ignoring the value of blast furnace gas and amortization, but including regular attendance, oil consumption, repairs and upkeep in German practice comes out as 0.04 cent for heating gas and 0.072 cent for power gas. With the above a degree of purity of one grain of dust per 1,000 cubic feet of gas for use in gas engines can be attained. The corresponding merits of Theisen washers can be ascertained from the table. As far as the hot blast stoves are concerned the thorough cleaning of the gas will eliminate the necessity to provide for reserves. Smaller heating surface, superior combustion efficiency, and higher temperatures in the blast stoves are some of the other advantages gained besides the saving in labor for removing the dust. Depending on the design and capacity of the stoves, the percentage of moisture contained in the air, the intensity of radiation, the quality of coke charged with the ore and the composition of the latter, and on the degree of purity of the gas, it is possible to reduce the quantity of gas supplied for heating the blast to from 25 to 18 per cent. The accompanying illustrations show the most remarkable constructions and installations of the different systems and apparatus used in cleaning blast furnace gas, in Germany.

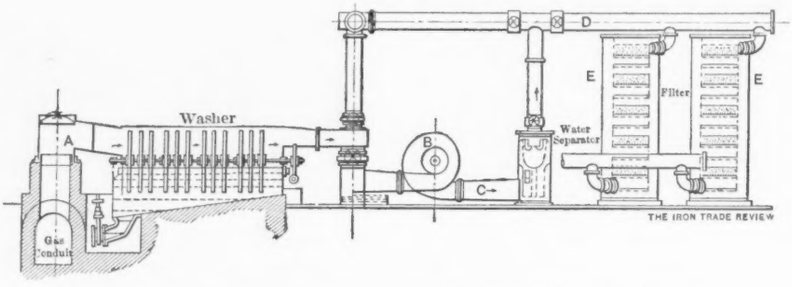


FIG. 2—GAS CLEANING PLANT WITH SLOWLY REVOLVING WASHER.

As regards the influence which the utilization of waste gases from blast furnaces (and coke ovens) may have upon the rate of increase of production, and upon the net cost of electrical energy, the results attained in the operation of the power stations of the Cockerill company, Belgium, during the past seven years, are noteworthy. In the year of 1900 their power plants had a combined output of 1,789,781 kilowatt-hours, which were generated by steam engines exclusively. At that time the net cost of operation, assuming that the blast furnace gas had no value, was 8.80 centimes per kilowatt. In 1905 the aggregate output of the plant had risen to 24,000,000 kilowatt-hours, which were generated by gas engines exclusively, the steam engines having been discarded. The net cost of operation had thereby been reduced to 0.65 centimes per kilowatt, a truly remarkable performance.

Gas Power at Differdingen.

As another instance may be cited the experience of the Differendingen Iron & Steel Works, Germany. Before the introduction of gas power, the amount of coal consumed for generating steam was 5,300 tons per month, the output of pig iron in the same period being 21,400 tons, of which 70 to 80 per cent was converted into steel and rolled, while the remainder was turned out as billets. The cost of coal at $4.30 per ton, was $23,000 or $1.07 per ton of pig iron. When gas engines were installed, the coal consumption diminished to about 500 tons per month, costing $2,180, while the output of iron has increased to 30,000 tons per month, the cost of fuel for power being therefore reduced to 7.2 cents per ton of iron. Assuming that under the former conditions with steam power the cost of fuel would have increased in proportion to the output of iron, the saving amounts to about $1 per ton, equal to $30,000 per month, or $360,000 per annum. At the same time the cost of handling the coal and attending to the boilers has greatly diminished. The cost of labor and repair is probably not greater with the gas plant than with the steam plant. It is estimated that the cost of the complete installation, including a sufficient proportion of plant for blowing would be $2,340,000; the saving of $360,000, therefore, amounts to 15.4 per cent of the new capital, amply sufficient to provide for depreciation, with a margin of

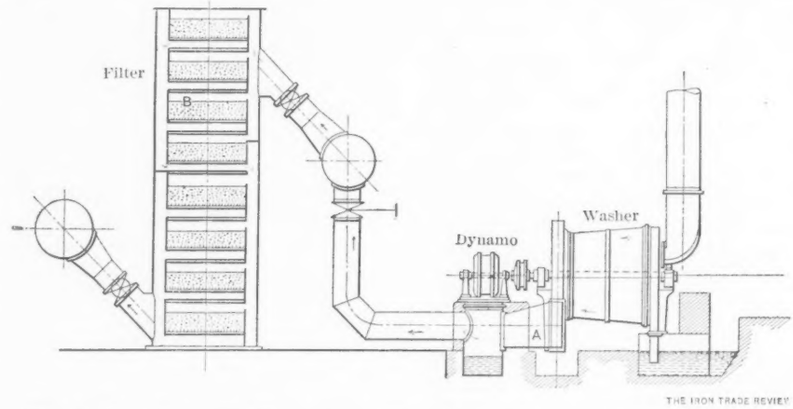


FIG. 3—GAS CLEANING PLANT WITH HIGH SPEED CENTRIFUGAL FAN WASHERS.

something like 10 per cent for interest. In view of these undeniable performances, which are only instances among many of similar nature, it is no wonder that we see even the lavish American iron industry making preparations to turn from extensive to intensive cultivation.

Coke Oven Gas Power.

In order to be able to secure maximum economy of operation, iron and steel works, whenever they are closely located to centers of fuel supply, are combined with coke oven plants and coal mines, so that the whole series of processes, mining, coking, smelting, finishing, by-product recovery and sale, may be carried out under one ownership. It becomes necessary, therefore, to examine the possibilities which are offered by regarding and utilizing the coke oven as a source of energy.

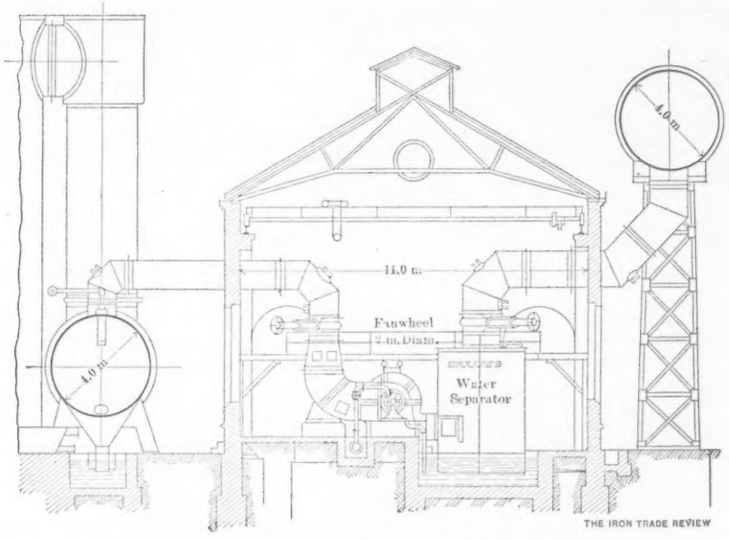


FIG. 4—GAS CLEANING PLANT WITH ORDINARY CENTRIFUGAL FAN WASHER.

According to L. Greiner, modern by-product coke ovens develop about 240 cubic meters of gas of about 4,000 calories thermal value per metric ton of dry coal containing 20 per cent of volatile matter and 5 per cent of ash. This gas is relatively high in hydrogen contents (over 50 per cent) and 65 per cent is required of the total amount for internal distillation processes, that is, for heating the ovens, while the rest of 35 per cent, or 336,000 calories, are available for motive power purposes, yielding an average of 135 horsepower per ton of coal. The amount of coke obtained from the distillation of one ton of raw coal is about 1,650 pounds. When charged into the blast furnace, together with the same quantity of ore, and after deducting the amount consumed in hot blast stoves and in the blowing department, this coke will give a power output of about 600 horsepower. So, after covering all internal requirements for the coking and smelting processes proper, there is left available for purposes inside and outside the works 735 horsepower from one ton of raw coal expended in the combined plant. It is further stated that the actual continuous power which becomes available in one hour per ton of coal charged to the coke oven is approximately 5.6 horsepower. This means that a modern coke oven of the by-product type of 7 tons capacity, considered as a producer of gas, is equal to a gas producer of 40 horsepower capacity. Figuring on an efficiency of conversion of 75 to 80 per cent, it can be taken that the production of power is about 7 horsepower per ton of coke per day, or roughly speaking, the available power per hour is equal to the number of tons of coke produced per week.

In practice the output of the various elements given above depends greatly on such factors as composition of coal, moisture content, and type of oven. Basing all figures on one ton of coal, unless otherwise stated, we find that the efficiency of conversion of coal into coke varies all along from 73 to 80 per cent. The quantity of gas produced ranges from 7,000 to 16,000 cubic feet, its calorific value varying between 300 and 650 B. T. U. per cubic foot. The coking time also varies between 24, 32 or 36 hours, while the capacity per oven is generally 6 to 7 tons. The quantity of gas required for heating the flues of the ovens depends greatly on the construction adopted and varies between 5,600 and 9,200 cubic feet per ton of coal, constituting from 58 to 80 per cent of the total amount generated. The rest is available for other purposes. One brake-horsepower requires from 20 to 30 cubic feet of coke oven gas, the best performance so far recorded from German practice being a consumption of only 7,800 B. T. U. per horsepower hour.

As to the by-products realized from the conversion process, one ton of raw coal will yield from 2 to 6 pounds of NH_3, or from 8 to 21 pounds of sulphate of ammonia, worth $57 per ton. Further, from 50 to 150 pounds of tar, selling at about $5 per ton in Europe, and from 9 to 16 pounds of benzol, bringing a price of about $50 per ton. Over 90 per cent of the total coke production is consumed in the metallurgical industries, the rest being used for domestic purposes.

Surplus Power Available.

The amount of surplus power available for purposes outside the coke oven plant depends, besides the conditions outlined above, on the demand for power for operating the machinery within the combined works. As an average example of German practice—considering now the coal mines proper—can be taken a colliery in the Ruhr district having an annual output of 600,000 tons, of which one-fourth is coked. From waste heat and waste gases a continuous capacity of 3,000 horsepower is obtained, of which as much as 2,500 horsepower, or 83 per cent, and sometimes more, is consumed within the works.

The largest German colliery, "Rheinpreussen," will shortly have an annual output of 3,000,000 tons, of which one-third is coked. A conservative estimate shows that 17,000 horsepower can be generated continuously in gas engines from the available coke oven gases. Owing to the small depth of shafts and little water influx, only 58 per cent, viz., 10,000 horsepower will be consumed within the works, the rest being available for other uses. In combined works these uses may be found, for instance, in the steel smelting plant for heating steel furnaces. This would mean that the gas is conducted from the ovens into the steel plant, without undergoing electrical transformation. In most cases, however, it is found practicable to conduct the gas to the central station and to burn it in large gas engines specially designed for the use of that

gas. The high hydrogen content introduces series modifications in the proportioning of the compression ratio and in the design of the combustion chamber. The cooling surface of the latter must be sufficiently large to prevent premature ignitions. In most cases the gas after leaving the by-product recovery plant has a degree of purity sufficient for use in gas engines. A matter of no mean importance is the proper distribution of the available electric power to the various uses: Hoisting service, pumping service, mine ventilation, etc. Some of these have a very fluctuating load curve. So it is advisable to connect the continuous services to the continuous sources of power: blast furnace and coke oven gas-driven central station department, while for intermittent or temporary services power gas may be generated by a bank of gas producers, burning low grade coals, mine culm, dust, etc. The capability of subdivision and the elasticity of operation makes gas producers very valuable adjuncts to a combined plant of this character.

Summarizing the application of gas power in colliery service, we may say that though the power factor or the demand for power within the plant, (coal mine and coke oven plant combined) is less predominant than it is in iron and steel works, and constitutes only a comparatively small item in the total operating expenses, it must be remembered that every cent saved through economic power generation and transmission in the production of one ton of coal or coke will yield tenfold and more in net profits returned from the sale of the finished products.

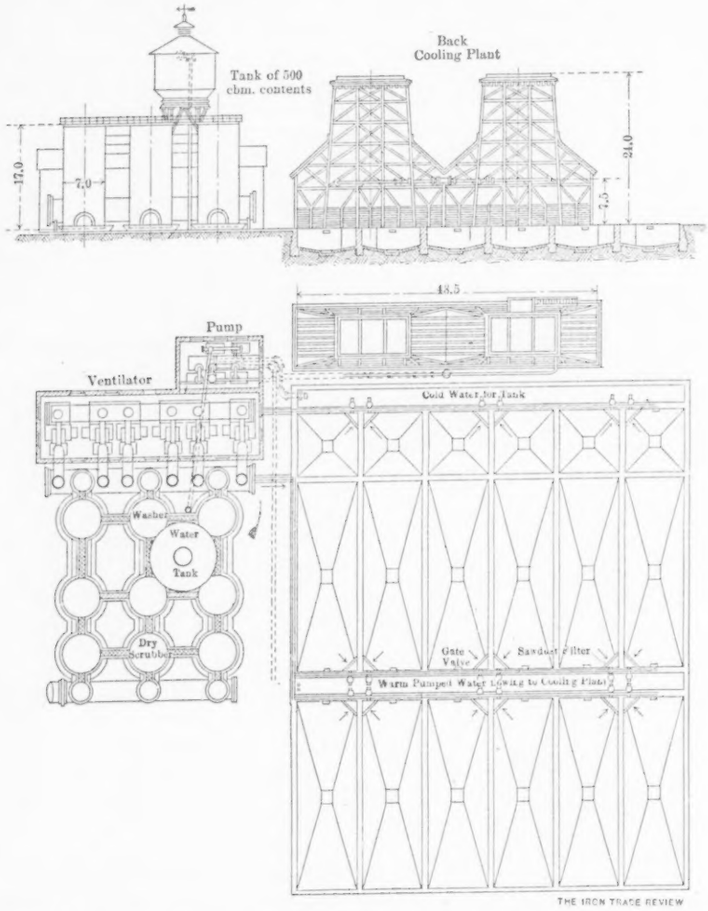


FIG. 5—LONGITUDINAL ELEVATION AND PLAN OF WATER BACK COOLING PLANT, LARGEST IN THE WORLD.

Dimensions in Meters.

Transmission and Distribution of Power from Coke Ovens.

Depending on local conditions, gas power can be distributed either in the form of high tension electric current or as compressed gas. The total operating expenses of the latter system are sometimes lower than those of the former, but among other reasons, the augmentation of complexities by the use of many gas engine driven substations and the necessity to provide skilled talent for all of them militates against the scheme. In Germany both systems have been tried, but the electric distribution has proven the more efficient as far as all round enonomy is concerned. The "Rheinpreussen" colliery, already mentioned, sends its surplus energy in the form of electric current at 10,000 to 20,000 volts, to the city of Krefeld and its new Rhein harbor, where it is transformed and sold at 1.9 and 1.7 cents per kilowatt-hour respectively. Other collieries and iron works are sending their surplus current to some large central station, which acts as a sort of electricity exchange bank, for further distribution. The most notable institution of this kind is the Rhenish Westfalien Electric Central Station, which pays to its suppliers 0.7 cent per kilowatt-hour for their surplus energy. Owing to its own large power plants, aggregating about 55,000 horsepower, and to the fact that it can save the reserves, it can sell energy at a very low rate. For instance, to large consumers such as factories, rolling mills and small collieries, etc., the charge is 1.4 cents per kilowatt-hour, and for driving motors which run at a constant high load factor, such as fans for mine ventilation, the charge is as low as one cent. This central station has also made contracts with several communities and cities, and has taken active part in the operation of smaller central stations and of electric railroads running through the commercial distribution sphere of their works. The tariff rates are based on a sliding scale, beginning at 7.6 cents per kilowatt-hour for light, and decreasing in proportion to the consumption to 3.5 and 1.4 cents, respectively.

I will conclude this investigation by an estimative calculation showing what degree of profitableness may be attained when a colliery or any other establishment, which possesses combustible materials that allow of more efficient utilization in gas engines and gas producers than is possible with the traditional means of steam power generation, takes advantage of the new development, realizing that power is money, regardless whether or not outside markets must first be conquered for selling it.

The question which arises first is: Which method of valuation of these gases should be adopted. In case of coke oven gas being available German practice differs considerably at different works. While they all realize that the gases must be credited as having some value, and also that the cost of cleaning, if any, must be charged against them, the standard of

appraising varies greatly. In some works the surplus coke oven gases are valued at the same price as the illuminating gas from the city gas works (18 cents per 1,000 cubic feet). This is obviously too high, considering that they are a by-product of other operations. In other plants the gas is appraised according to its heating value, coal at selling cost serving as the measure of comparison. When the price of coal at the works is $2 per ton, and the calorific value of the surplus coke oven gas is 392 B. T. U. per cubic foot, this mode of appraising would make its value equal to about three cents per 1,000 cubic feet, which is the price to be quoted in the balance sheet of the works. We can now determine the total cost at the switchboard of one kilowatt-hour generated in coke oven gas engines. It is assumed that a colliery which has hitherto wasted its surplus gas by insufficient equipment installs a 1,000-horsepower gas engine and generator and establishes connections for the disposal of electric current with some overland central station as described above. This station buys current from a number of contributors at low rates and sells it again to cities, railways, industrial establishments, etc., at a profit. The small contributors, besides increasing their earning capacity, derive this advantage from a mutually beneficial agreement of this character that they can operate their prime movers at a constant high load factor, thereby securing the maximum possible income from the capital invested. Another advantage is that they need not install reserves, since in case of a breakdown occurring in their power plant, they are entitled, by agreement, to take electric current from the net. Hence the interest on the capital which they would have to expend otherwise for spare units, without getting any remunerative returns from them, is saved, and the net income of the plant is increased accordingly.

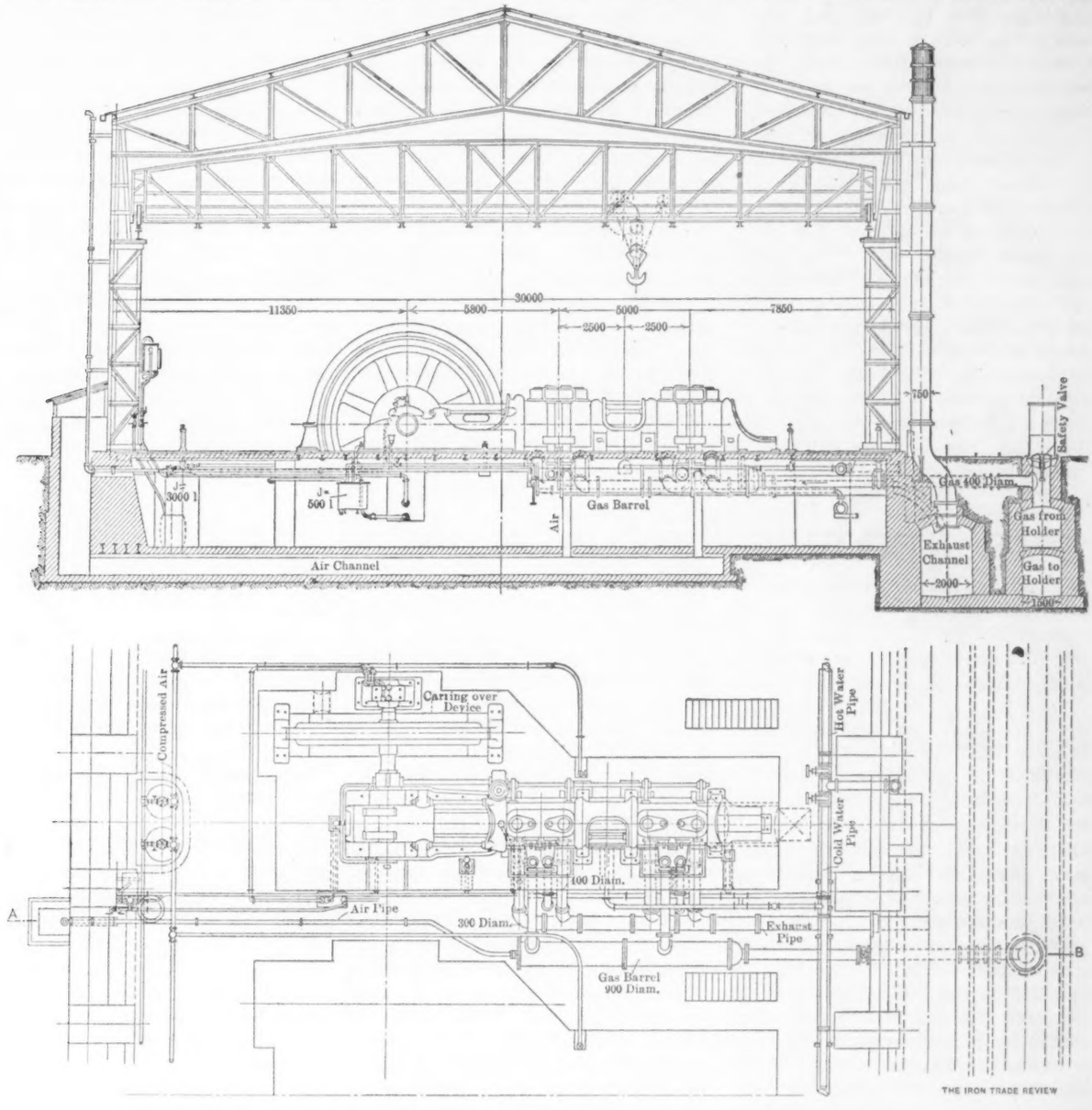


FIG. 6—COMPLETE GAS POWER PLANT, HASPER IRON & STEEL WORKS; 1,500-HORSEPOWER NURNBERG ENGINE.
Dimensions in Millimeters.

Assuming, further, that the 1,000-

horsepower coke oven gas engine operates 6,000 hours a year and that the initial cost of engine, piping, generator, switchboard, building, water cooling tower, is $55,000 or $55 per horsepower (with German prices) then with an annual interest on the capital of 4 per cent, an amortization of 10 per cent, which is a liberal allowance considering that buildings and other parts are included in this price which do not depreciate so fast, and 1 per cent for upkeep, or 15 per cent altogether, then the various items for one electrical horsepower-hour figure out as follows: Interest, amortization and upkeep, 0.136 cent; cost of attendance, 0.012 cent; cost of lubrication, waste, etc., 0.009 cent. In addition there is the fuel cost, which came out as 3 cents per 1,000 cubic feet, with the valuation adopted above. With an average gas consumption per horsepower-hour of 24.7 cubic feet, the gas cost is 0.071 cent. Therefore, the total cost for one effective horsepower-hour comes out at 0.23 cent, or for one kilowatt-hour 0.33 cent.

After having thus determined the total cost of operation of the proposed plant, it remains to calculate the value of the electric current which is available for sale. This, of course, is strictly a matter of locality. But to give an example from German practice we will assume that the current will fetch a price of 0.7 cent per kilowatt-hour, or of 0.5 cent per effective horsepower-hour. With this assumption, our central station, which generates $6{,}000 \times 1{,}000 \times 0.67 = 4{,}000{,}000$ kilowatt-hours, receives a remuneration for the same of $28,600 per annum. The total operating expenses amount to $13,300, so that there remains a yearly surplus of $15,300. In other words, the initial capital investment for one coke oven gas engine and electric generator of $55,000 yields an annual interest of 27.8 per

It is seen that the system of electric canalization of large industrial districts, which has been made possible through the rational utilization of metallurgical gases and other waste, and which is so extensively practiced in Germany, has a very favorable aspect to it as far as immediate remunerative profits and returns are concerned. The technical difficulties in the design, construction and operation of engines, generators, transmission, conversion and transformation have been successfully overcome, and the present state of the art guarantees a high degree of commercial efficiency.

The question now before us—which is the same in every country—is this: What effects will this tendency towards centralization of power generation have on the development of the national industry? What consequences will it entail for the issue of the struggle between the large manufacturing undertaking and the small independent producer? Who should control the sources of supply which provide heat, light and power; that is, the supporting elements of every industry, from one central place to large districts; shall this novel power be surrendered to the monopoly of private corporations or individuals, to whom immediate personal gain outweighs all other considerations, or shall it be placed in the hands of the government?

THE RECOVERY OF IRON FROM CUPOLA SLAG

By Robert Grimshaw.

In melting pig, etc., in the ordinary foundry cupola, there is always a certain loss represented by the difference between the pig and scrap charged, and the amount poured. This difference, or melting loss, consists of two separate items, as follows:

1.—That iron, together with its alloy or mixture of silicon, manganese, etc., which is actually burned and passes into the slag.

2.—That portion of the iron which is only mechanically absorbed by or contained by the slag.

The first item can be very materially reduced by proper choice of the type of cupola, and understanding of the melting process. The second is composed of iron in such finely divided condition that its recovery from slag, melting sand, etc., has hitherto been considered impossible. The larger particles can, of course, be got out by hand, but this portion of the otherwise lost metal is of but little consequence, and depends on the character of the castings; and even after one had saved this amount, there would remain a large percentage of the iron in the form of fine particles. This amount often reaches 9 to 12 per cent, according to Dr. Eckwald, who has paid much attention to the subject, and has a paper thereon in the *Eisen Zeitung*. Naturally, less would be recoverable if the iron was allowed to rust by long standing; and in old slag heaps it would not be worth while to try to recover any such iron by any process whatever.

Experiments have been made for a long time to recover the iron by magnets; on the principle that the slag itself is non-magnetic and the iron particles mixed therewith are magnetic. The progress of electro-technics, and particularly the employment of magnets, rendered this method possible, especially as a continuous current is usually at hand in modern foundries for lighting, etc.; and there are already many magnetic separators, for the extraction of the iron from the slag, all acting on the same principle, that the magnets are strong enough to extract from the slag even the largest particles of iron.

In order to be really effective, such apparatus must have the following properties:

1.—The magnetism necessary must be easily and cheaply obtained.

2.—The iron and the remaining material must be easily separated, and delivered apart from each other.

3.—The construction of the apparatus must be simple, and it must be readily accessible for repairs, replacement of injured or worn-out parts, etc.

It is best to employ rotating magnetic fields and to let the material which is to be separated fall through them as near as possible to the magnetic poles.

Most of the separators in use—German as well as foreign—are built on about the same principle. The author of the paper states that at present German separators are preferred over there, even by firms that once had a preference for everything American.

The material is fed into the apparatus in pieces not over the size of a fist, and the metal delivered is quite free from dust, because the particles of slag which adhered thereto have been rubbed off by their friction among themselves. The power consumed is not very great. Kniaschow states that in his foundry for a separator that handles 60 tons of slag per day of 10 hours, only five horsepower is necessary. When one considers that there is often 9 to 12 per cent of metal in the slag, it will be seen that such apparatus pays.

RECENT PROGRESS AND PRESENT PROBLEMS IN THE BLAST FURNACE INDUSTRY[1]

By John J. Porter.[2]

The engineering and metallurgical problems connected with the operation of the blast furnace are discussed by the author in this article. The conditions on which efficient operation depend are disclosed, and the effect of various factors on the working of the furnace are presented. The improvements to be made are largely problems that must be worked out by the metallurgist and these problems are clearly laid out by the author.—Editor.

The iron industry has made great advances in the last few decades, and has attracted wide attention, not only among technical men, but also among the public at large. Considering the period as a whole, the greatest and most spectacular improvements have been due to the engineers, but quite recently conditions have changed somewhat and the metallurgist has to a considerable extent superseded the engineer. His successes, the less spectacular to the layman, are to the mind trained to comprehend them, quite as marvelous, and it is with his work that we shall deal particularly.

Directions of Progress.

The progress of the blast furnace industry, from a technical standpoint, may be classified under three heads: Increased production, economy in fuel, economy in labor. Of these divisions the credit of the first belongs jointly to the engineer and metallurgist, of the second almost exclusively to the metallurgist, and of the third almost exclusively to the engineer. I will, therefore, confine myself chiefly to the first and second topics, taking them up in order.

Increase in Production.

Twenty years ago, or in 1887, we were producing in this country some 6,000,000 tons of pig iron per year. Today we are making 27,000,000 tons in the same time, an increase of over 400 per cent. In the same time the number of active furnaces in the country has changed from approximately 350 to about 450, an increase of about 30 per cent only. From this it is apparent that the average capacity of the individual furnace has been more than tripled in 20 years, and this rapid change has been, perhaps, the most striking feature of the iron industry.

The credit for this achievement, as I said before, belongs about equally to engineer and metallurgist, the engineer taking the initiative in the building of larger and larger units, while the more conservative metallurgist has had his hands full in overcoming the mistakes of the original builders, and putting the plants finally on a successful basis. To these, perhaps, should be added those mining men whose energy has given us the rich Lake Superior ores, and the capitalist whose courage has made possible the huge experiments characteristic of the iron and steel industry.

Size of Furnaces.

Now to discuss the matter of output in somewhat greater detail. The capacity of any furnace is, of course, dependent upon, first the size of the furnace, and second the rapidity of driving, or in other words, the amount of iron made per unit volume of furnace. The increase in size of furnaces is, as I said before, an engineering feature. Twenty years ago the most favored size was about 70 feet high by 15 feet greatest diameter, with a volume of about 11,000 cubic feet, and an average output of about 100 tons per day. In the first half of the present decade, when the movement towards large furnaces had reached its culmination, the average new furnace was about 95 x 22 feet, with a volume of about 22,000 cubic feet, and an output of about 400 tons per day. The increase in size, therefore, has just about doubled in this time, and the remainder of the increased production is due to improved metallurgical methods resulting in more rapid driving.

Expression for Rate of Driving.

Now to take up the factors upon which the output per unit volume of furnace depends. It can be shown by calculation that this output in tons of iron per cubic foot of furnace per day, is equal to

$$\text{yield} \times \frac{\text{ore}}{\text{coke}} \times 0.638 \times \frac{\text{cu. ft. blast per cu. ft. of furnace per min.}}{\text{cu. ft. blast to burn 1 lb. coke}}$$

These factors are quantities which are daily observed at most furnaces, and may be closely approximated at any new furnace. The formula, therefore, affords a ready means of calculating the probable output of any new furnace, and will usually be found to be very accurate.

The nature of these factors of output is almost self evident, but their bearing on the increased capacity of furnaces affords a field for profitable discussion.

Yield.

The discovery of the enormous deposits of iron ore in the Lake Superior district has exerted a far-reaching effect on blast furnace practice in this country. These ores were first introduced in a small way in 1854, but by the year 1887 they furnished approximately 50 per cent of our pig iron, and at the present time nearly 80 per cent of our total production is made from them. It is because of the increasing use of these rich ores that the average yield of ores for all the furnaces of the United States has increased during the last 20 years about 2 per cent, or from about 52 per cent to about 54 per cent, and this increase would have been much greater but for another consideration, namely, the decrease in the yield of Lake Superior ores during the same period. Ten or 12 years ago, or shortly after the exploitation of the Mesabi, the latest and richest of the Lake Superior ore ranges, the average iron content of lake ores was 59 to 60 per cent. Today they will hardly average 54 per cent. In the old days the furnaceman insisted on having high grade ores, and the mines being operated independently and being subject to keen competition, were robbed of their richest ores by wasteful mining methods. Now, however, the furnacemen are their own miners and the ores are taken out as they come. It is becoming realized that the word "inexhaustible" cannot apply to ore deposits, no matter how vast, and a policy of the strictest economy has become almost universal.

Fuel Ratio.

The fuel ratio $\frac{\text{ore}}{\text{coke}}$ is dependent chiefly on the chemical composition and physical structure of the stock used, ore, coke, and flux, but is also subject to a certain extent to the skill of the furnace manager. Numer-

[1] A lecture given Oct. 16, 1907, before the Cincinnati section of the American Chemical Society.

[2] Assistant professor metallurgy, University of Cincinnati.

ically this factor may vary from 1.5 to 2.5 under varying conditions, and on an average it has probably changed very little during the past 20 years. As it is so intimately connected with certain aspects of the subject of fuel economy, it will be more convenient to discuss it in detail under that head.

Rate of Blowing Furnace.

A large part of the increased production of recent decades has been due to increase in the last factor of our output formula. The numerator of this ratio, or cubic feet of air per cubic foot furnace per minute, now ranges for good practice from 1.8 to 2.2. Twenty years ago it would run about 1.5. At first glance it might seem as though this factor could be increased indefinitely, but unfortunately this is not true, for a point is soon reached where an increase in the volume of air blown per unit time cools the hearth of the furnace and results in "off" or unsalable iron.

Limitation to Rate of Blowing.

The cause for this is not difficult to trace, although I have never seen it adequately explained in print. Assume a given coke, uniform in fineness and cellular structure, and therefore having a definite surface per unit volume. Now this given surface is capable of carbonizing or combining with a certain definite quantity of air in a unit of time. At least this is true for uniform conditions as to temperature, pressure, etc., which may effect equilibrium, and which we will assume to be constant. If now the air be supplied in this quantity per unit of time, we will have the maximum rate of combustion, while if it is supplied in excess of this quantity some of the oxygen will escape carbonization.

Application to Hearth of Furnace.

Applying this reasoning to the blast furnace, we have the hearth of the furnace filled with coke, this coke affording a certain definite surface to the action of the blast. As the coke is constantly being replenished from above, the extent of this surface remains practically uniform. If now air be blown in, first at a rate less than the rate at which it can combine with this coke surface, and then be gradually increased up to the maximum rate of burning, then it is apparent that the heat generated per unit of time will also increase, and, as the heat losses due to radiation, etc., remain constant, the temperature will increase. If, however, we increase the air still more, a portion of the oxygen will pass uncarbonized through the hearth, and will only combine with carbon in a higher zone, thus in furnace parlance "raising the zone of combustion." The heat generated up here is of no value to the hearth, and is positively harmful in that it tends to cause certain derangements of the furnace. Moreover, the excess air which passes through the hearth robs it of heat and reduces the temperature here where high temperature is needed. It is probable that a reduction in temperature causes a decrease in the rate of combustion per unit surface, and that the cooling therefore becomes cumulative.

Lack of Data.

It is unfortunate that we have so few numerical data with regard to this phenomenon. Besides the constants which the physical chemists should furnish us, we need laboratory methods for the determination of the surface factor and rate of combustion of coke, and much information as to the time of exposure needed for the reduction of the various ores. At present it is impossible to theoretically derive this factor, and it must be obtained through trial and experience.

Blast per Pound of Coke.

The denominator of the last factor in our output equation, cubic feet of air required to burn a pound of coke, is dependent almost entirely on the efficiency of the valves of the blowing engines and the tightness of the blast connections, and also on the temperature of free air. This follows since the volumes are by engine measurement and the weight of air used in the furnace per pound of coke is nearly uniform, varying chiefly with the percentage of fixed carbon in the coke. The numerical value may range from 60 cubic feet for a new and well maintained plant up to 120 cubic feet or more for an old plant in poor repair. Such conditions are not uncommon in some districts, and I have myself had some heartbreaking experiences in this connection. Needless to say this factor is much lower now than 20 years ago, and for this we have to thank the mechanical engineer.

Tendency Towards Smaller Furnaces.

To return now to the increase in the sizes of furnaces, I have already spoken of the influence of this upon the increase in production. At the present time, however, the tendency seems to be towards a somewhat smaller furnace and a slightly lower average output; the reasons for this being metallurgical and connected with the poorer fuel consumption of the largest furnaces. The most favored sizes at present are, for furnaces making low silicon iron for steel works from Lake Superior ores, 85 to 90 feet high and about 22 feet greatest diameter; and for making foundry iron from Lake Superior ores, about 80 x 20 feet. In the south, where lump ores are used, there is much less uniformity in the size of furnaces, as well as in other conditions of furnace practice, perhaps about 85 x 19 feet is a fair average, the narrower stack working satisfactorily with the different character of ores.

Cause of Failure of Large Furnaces.

The cause of the unsatisfactory results obtained with the largest furnaces is found in the inability of the coke to stand the pressures put upon it and in the difficulty of getting a proper distribution of the blast. The theoretical height of column of furnace stock which any coke will support may be calculated from its compressive strength, but the results are misleading. Long before this limit is reached the abrasion of the coke has become so great as to form a densely packed mass in the furnace, giving rise to scaffolds and other irregularities. It is a question whether a rattler test, as applied to road making materials, would not give a truer index of the physical suitability of coke.

With regard to irregular distribution of the blast, or "'blast wandering" as it is sometimes called, it is patent that this will result in an irregular descent of different portions of the column of stock, and this in turn gives rise to "slips," whereby the hearth is cooled at irregular intervals and much extra fuel is required to keep up the grade of iron. Of course, with large furnaces the cross sectional area over which the blast must be distributed is much increased with a corresponding increase in the difficulties of such distribution. Still another factor limiting the size of furnaces is found in the necessity of proper distribution of the stock at the top, together with certain ratios between the several dimensions which must be observed. Other factors, important, even if more obscure, also exist, and the net results of them all is to limit, under present conditions, the most favorable height of furnace to from 80 to 90 feet, with a bosh diameter of about one-fourth of the height.

Output Records.

Perhaps a few notes here on the output records of modern furnaces may be of interest. These records are made and broken so rapidly

that it is a rather difficult matter to keep up with them, but to the best of my belief the championship today is held by the Duquesne plant of the Carnegie Steel Co., four furnaces of which during March, 1906, made 80,593 tons of iron, or an average of 650 tons per furnace per day. One furnace of this group averaged 760 tons per day for seven successive days, and on one day 832 tons. The record for a single day's output is held by No. 9 furnace of the Illinois Steel Co., which on May 16, 1905, made 957 tons, a record which seems likely to stand for some time. It is true that these daily records are made by turning the furnace into a cupola and charging all the scrap saved for weeks, but nevertheless this record is a wonderful thing to contemplate in comparison with conditions less than a century ago when an output of 20 tons was considered a remarkable day's work.

Fuel Economy.

In comparing the fuel economy of the present with that of the past we must bear in mind that the figures for coke consumption are by no means necessarily proportional to the heat efficiencies of the furnaces. For example, it is quite possible for a furnace running on very lean ores with a large fuel consumption to have a higher thermal efficiency than another furnace running on rich ores and with a much lower fuel consumption. In other words, the percentage of heat usefully applied depends on the amount of heat theoretically required in each individual case, as well as on the amount of heat supplied.

As the ores used today will average at least 5 per cent lower in iron than those in use 10 years ago, and as the average coke has also deteriorated in quality (due to the exhaustion of the purest coal beds) it is small wonder that the furnaces of today fail to equal, or indeed to approach the low records for fuel consumption made in the preceding decade.

Past and Present Records.

What is probably the greatest economy of fuel ever attained was made by No. 6 furnace of the Illinois Steel Co., which during the year 1897 averaged but 1,580 pounds of coke per ton of iron. During the decade 1890-1900, average fuel consumptions of 1,800 to 1,900 pounds of coke per ton of iron were common and expected at furnaces using Lake Superior ores, while the same furnaces today are using 2,000 to 2,200 pounds, and the recent 7-day average of No. 1 Duquesne furnace of 1,896 pounds receives notice as being something remarkable. In other districts the same condition holds. For example, Phillips in his admirable bulletin on "Iron Making in Alabama," gives the average fuel consumption for the state during the year 1895 as 3,158 pounds per ton of iron, while at the present time similarly situated furnaces are using 3,300 to 3,400 pounds.

Calculation of Heat Efficiencies.

Now the calculation of the absolute or theoretical heat efficiency of any furnace is an operation fraught with much difficulty. The factors entering into such calculation are so many and so complex, and certain of the principles involved have been so recently set forth and are as yet so poorly understood that in actual cases the data are rarely sufficiently complete to permit of an exact solution of the problem. However, approximate calculations and comparisons can readily be made, and from the results of these it seems almost certain that there has really been a falling off in the absolute thermal efficiency of our furnaces as well as in actual economy of fuel.

Cause of Poor Thermal Efficiency.

Naturally the cause for this condition has been most earnestly sought, and after several years of study and discussion the weight of opinion seems to incline to the belief that it is due to certain mistakes which have been made in furnaec construction, these mistakes in turn being due to a too great reliance on engineering and a corresponding neglect of metallurgical principles. This trend of opinion is of very recent development, but is already beginning to be felt in an increased demand for metallurgical knowledge.

Classification of Mistakes.

The mistakes of construction which have been referred to may be classified as: Too large furnaces, wrong lines of furnaces, and mechanical filling devices which cause a poor distribution of stock. The effect of too great height has already been spoken of and needs no further discussion, but the effect of the lines of the furnace upon its working may be profitably considered.

Effect of Mesabi Ores.

Some 12 years ago, when the fine ores of the Mesabi range were first exploited on a large scale, it was found that their use involved very serious difficulties. A furnace using a large proportion of these ores would periodically hang up, as it is called. That is, the stock would refuse to descend in the furnace, and the resistance to the passage of the blast would increase from the normal 12 or 15 pounds up to as high as in some cases 30 pounds. Finally something gave way, and the stock fell suddenly. The released pressure caused it to foam up and out of the furnace very much like champagne out of a bottle. Not infrequently the whole top of the furnace was lifted, and cases have been recorded where it was completely emptied of material. Needless to say these phenomena involved serious derangement of the working of the furnace, and extreme danger to those charged with its operation. As an example of this danger, the writer has seen as much as two carloads of coke blown out of the top of a furnace, to fall as a red-hot rain over a radius of a hundred yards. I have also seen as many as 16 men taken to the hospital after one of those slips, all suffering from burnt and cut heads, shoulders and backs.

Cause of Slips.

For many years the cause of all this remained unexplained, although theories galore were propounded and empirical methods were discovered by were somewhat mitigated. Yet through all these years the true explanation was available, for as early as 1896 O. O. Laudig, then chemist for the Buffalo Furnace Co., had proven by laboratory experiments that the Mesabi ores are far more readily reduced than others, and that during reduction an enormous expansion in volume takes place. The great significance of his experiments did not receive at the time the appreciation which they deserved, but later they became the basis of the reasoning which resulted in the first wide furnace.

Sequence of Hanging.

Now what takes place in the blast furnace is this. The fine ore, being reduced very high up in the furnace, and at the same time swelling enormously in volume, is pressed against the sides of the furnace and forms an arch or scaffold across the furnace, the material also being much compacted and thus offering great resistance to the passage of the blast. The stock beneath this arch soon burns out, leaving a more or less large vacant space, and when, as must sooner or later happen, the arch gives way, the large volume of high pressure gas beneath produces by its sudden release the explosive effects. It is also possible that there may be at times some free oxygen in this gas, the action of

which on the very fine deposited carbon contained in the material of the arch could much increase the violence of the slip.

Bearing on Furnace Lines.

The effect of furnace lines upon this slipping can now be understand. Evidently the greater the slope or overhang of the inwall the more space has the reduced ore in which to expand the less chance has it to form arches. In 1903 the first large furnace embodying these principles was built at the Clairton Steel Works and the results were a revelation to the metallurgical profession. In this and other furnaces built along similar lines it has been found possible to use from 80 to 100 per cent of Mesabi ore with less serious slipping and lower fuel consumption than is customary in straighter furnaces using less than 50 per cent. As some 60 per cent of our Lake Superior ore is supplied from the Mesabi range, and as costs of mining are much less there than elsewhere, the importance of this is patent.

Mechanical Filling.

I will now take up the question of mechanical filling, the solution of which problem has been an important step in advance. In solving it, however, serious mistakes were first made by the engineer designers, and it was only by the co-operation of the metallurgist that final success has been achieved.

The form of top which was first devised consists in its essential features of a self-dumping skip hoist for elevating the stock, and a double bell and hopper system so arranged that one bell is always closed, thus protecting the mechanism from the heat of gas and flame, and also saving a large amount of gas which was wasted in the old single bell system. A variation which won great popularity is the Kennedy tight top, the invention of Julian Kennedy. The main features of this top are, first, the fact that it is securely and directly riveted to the shell of the furnace; second, that it is without explosion doors or other safety vents to relieve excess pressure, and third, that it is constructed to withstant an internal pressure of at least 30 pounds to the square inch. This top was designed with the idea of confining the sudden pressure of slips, and forcing the gas to escape slowly through the ordinary channels, that is through the downcomers. The top answers this purpose admirably, for by throttling the escape of gases at the top the greater part of the stock is permitted to settle back into the furnace, and that which is carried out passes over into the dust catchers without endangering the safety of furnace workers.

In both of these forms of filling apparatus the fault is the same, namely, imperfect distribution of the materials, resulting in channeling of the blast, scaffolding of the stock, higher fuel consumption, and much "off" iron.

Sequence of Cause and Effect.

The sequence of cause and effect is as follows: The material in the skip being more or less jarred during its elevation tends to segregate, the finer material sifting to the bottom, and when the skip is dumped will slide out onto the near side of the hopper, while the lump is largely thrown to the opposite side. This segregation of sizes is most apparent with the coke, and may readily be detected by the eye. With ore and stone it is less apparent, but undoubtedly takes place to some extent, depending largely on the amount of moisture contained. The fine material being now on one side of the upper bell falls onto the same side of the lower bell, and thence to the same side of the furnace. Now because of the excess of fine material on this side of the furnace a greater resistance will be offered to the passage of the blast, more air will pass up the other side, combustion will be more rapid, and the stock will descend faster here. Eventually the fine material will accumulate, paste together, and stick to the side of the furnace so that we have the condition known as a scaffolded furnace. The blast now still further deflected to the open side impinges sharply on the lining here, and soon cuts it out, forming a "hot spot" on the outside of the furnace. This, unless met at once by prompt and energetic measures, may become very serious, even burning through the shell of the furnace. In addition, the scaffold after building out to a certain point will break off in part, and the mass of cold material falling into the hearth will lower its temperature, even to the extent of sometimes chilling the iron there, while the scaffold will gradually build out again and periodically repeat this performance.

Remedy, Rotary Distributors.

After the metallurgist has traced out the cause of these irregularities means were soon devised for overcoming them. During the past few years a number of rotary distributing devices have been patented. These retain the double bell and hopper system, but in addition provide mechanical means for distributing the fine and lump material uniformly around the circumference of the hopper. Several of them have come into extended use in the past few years, and a notable improvement in the furnace work has in almost every case resulted.

The Dry Air Blast.

We now come to the discussion of a topic which has recently received wide attention, and with which you are to some extent familiar. I refer to the dry air blast process, the recent invention of which by James Gayley, vice president of the United States Steel Corporation, will probably prove to be the most important advance in the direct economy of the blast furnace of the century, while in addition it has opened our eyes to a magnificent vista of theoretical possibilities.

Effect of Moisture in Blast.

It has long been known that the moisture in the air blown into the furnace was a scource of loss, this moisture being decomposed at the temperature of the heat into hydrogen and oxygen, with a resulting absorption of heat. This heat loss, as shown by calculation, amounts to a very small proportion of the whole and has always been considered by metallurgists as relatively unimportant, so that it remained for Mr. Gayley to actually try the experiment on the large scale.

Dry Blast at Isabella Furnace.

At the Isabella furnace in Pittsburg he installed a refrigerating apparatus through which all the air pumped by the blowing engines first passed. The moisture was here deposited as frost, and the air going into the furnace contained only a very small and practically constant residue of moisture. As about four tons of air were required per ton of iron made, and as it was necessary to provide for a production of at least 400 tons per day, it can readily be seen that this was a large and expensive experiment, and one only possible to a person, who like Mr. Gayley, commands the resources of a wealthy corporation.

The results obtained by this process were magnificent, and far surpassed anything which could have been reasonably expected. In place of the 5 per cent saving in fuel which some metallurgists had calculated, a saving

of 20 per cent was made, while at the same time the output was increased about 20 per cent and some minor economies were manifested.

Explanations of Process.

These results were published by Mr. Gayley in 1904 and were explained by him as being principally due to the constancy in the amount of moisture rendering the working of the furnace more uniform and requiring the carrying of less reserve heat in the hearth. They, of course, attracted wide attention, but his explanations were by no means entirely satisfactory to the metallurgical world, and in the discussion that followed they were severely attacked. Indeed, some of our German friends even went so far as to insinuate more or less directly that the results were impossible, and that therefore must have been doctored. However, in the following year J. E. Johnson Jr., a furnace superintendent of Longdale, Va., worked out what is undoubtedly the true explanation of the process, and at the same time propounded a new theory of the heat requirements of the blast furnace which has at one stroke placed the smelting of iron on a sound theoretical basis. This theory has since been elaborated by Prof. H. M. Howe, of Columbia University, and the net results may be said to be scarcely less important than the original invention of Gayley; since by this theory all of the means of attaining fuel economy are clearly pointed out, and furnace practice is removed from the empirical and placed on an exact basis.

Theory of Critical Temperatures.

This principle, which may be called the theory of critical temperatures, when reduced to its simplest terms may be stated as follows: In many heating operations there takes place at some definite temperature a heat absorbing reaction or change of state. The minimum temperature at which this can occur is termed the "critical temperature," and it is only the heat units delivered at or above this point which can be utilized.

As the clear understanding of this principle is essential in our following discussion of fuel economics, I will elaborate somewhat, and borrow a few illustrations from Prof. Howe's most lucid discussion. Continuous heating apparatus in which the heat is derived from heated gases may be divided into two classes; those which have and those which have not a critical temperature, at and above which more heat is needed than at the average of the temperatures below it. If there is no critical temperature then it suffices that there shall be some margin between that initial temperature of the heating gases and the temperature to which the objects are to be heated, and the breadth of this margin is of secondary importance. If, on the other hand there is a critical temperature then the margin must be at least as great as called for by the proportion

$$(T_i - T_c) : T_c :: H_c : H_b \text{ or } T_i = T_c\left(1 - \frac{H_c}{H_b}\right)$$

where T_c = critical temperature, T_i = initial temperature of heating gases (in most cases the temperature of combustion), H_c = heat to be supplied above the critical temperature, H_b = heat to bring the body to that temperature.

Examples.

Take the case of water as an example. If it is desired only to heat it to 100 degrees Cent. without boiling it then the operation belongs to the first class; the heating gases may be supplied at only the narrowest possible margin above 100 degrees Cent., and yet by proper contact they may be made to give up all of their heat to the water, so that a theoretically perfect heat utilization is obtained. If, however, it is desired to boil the water the case is different. Not only must we supply 100 calories per gram to heat it up to 100 degrees Cent., but we must also supply 536 calories at a temperature above 100 degrees in order to convert the hot water into steam at the same temperature. Please note particularly that the 536 calories must be supplied at a temperature above 100 degrees, for this is the important point, and it is quite evident that it would not avail for the purpose of boiling to supply an infinite number of calories at any lower temperature. Of course, the obtaining of this large amount of heat at a temperature above 100 degrees Cent. necessitates a high initial temperature of the heating gases if we are to have efficient utilization of our heat. A concrete example will make this plain.

	H_c in 1 gm. calories.
To boil water	536
In gases at 101 degrees	1
In gases at 636 degrees	536
In gases at 1,272 degrees	1,172

Suppose for simplicity that the heating gases as well as the heater have a specific heat of 1. Then if they be supplied at 101 degrees Cent., the heat available for boiling will be 101 — 100, or 1 calorie per gram of gases. Wherefore it will require for boiling one gram of water, 536 grams of gases. The total heat contained in these will be 536 × 101 or 54,136 calories, and as it only requires 100 + 536 or 636 calories to boil the water, we are only utilizing $\frac{636}{54{,}136} \times 100$, or 1.17 per cent of our heat. If on the other hand we supply the gases at 636 degrees Cent., then the heat available for boiling will be 636 — 100, or 536 calories per gram. Only one gram of gas containing 636 calories will be required, and our heat efficiency will be $\frac{636}{636} \times 100$, or 100 per cent. In addition it is evident that at any temperature above 636 our gases can perfectly utilize their heat, and the accompanying table, in which the symbols used are the same as in the formula previously given, summarizes these results:

H_b in 1 gm. calories.	Total heat in 1 gm. calories.	Weight of gas to boil 1 gm. water grams.	Heat efficiency per cent.
100	636	...	.....
100	101	536	1.17
100	636	1	100.00
100	1,272	½	100.00

The Case of the Blast Furnace.

Returning to the specific case of the blast furnace, it is evident that we have here an operation involving a critical temperature, or in fact several critical temperatures, the chief of which come at the melting points of iron and slag. As these points are not so very far apart, it is sufficiently accurate for most purposes to consider only a single critical point, which is placed by Mr. Johnson at the free running temperature of the slag, or under average conditions at about 1500 degrees Cent.

Applying our previous reasoning we must have for maximum efficiency: Heat available above T_c equal to or greater than heat needed above T_c. In other words, to increase the efficiency, we can increase the heat supplied, or decrease the heat needed above the critical temperature. Now the drying of the blast acts in both ways. The heat needed is decreased because there is no moisture to be decomposed into hydrogen and oxygen, a heat absorbing reaction which only takes place at high temperatures, while in addition the temperature of combustion, T_i, and therefore necessarily the heat supplied is considerably increased.

This latter assertion I can perhaps make somewhat more clear. We have

Heat supplied $= (T_i - T_c) \times$ weight of gases $\times$ specific heat of gases.

But

$$T_i = \frac{\text{net heat developed by reactions}}{\text{weight of gases} \times \text{specific heat of gases}},$$

and substituting this in the first equation we have:

Heat supplied = Net heat of reactions $- (T_c \times$ weight of gases $\times$ specific heat).

Now the net heat developed by the reactions is equal to the heat of combustion of the fuel less the heat absorbed by the decomposition of the moisture, wherefore the source of our saving is evident.

Finally, to summarize, the dry blast widens the margin between the temperature of combination and the critical temperature, and therefore produces an increase in efficiency measured by the increase in the heat delivered above the critical temperature, rather than by the increase in total heat supplied. The case is perfectly analogous to the fact that if gases which are to boil water be raised from 101 degrees to 105 degrees Cent., or by only 4 per cent, the heat theoretically available for this purpose is increased by some 400 per cent.

To take up now the problems pressing for solution upon furnace metallurgists, it must be remembered that, as the blast furnace is a commercial proposition, its problems, when resolved into their ultimate elements, have all to do with the reduction of cost, or what amounts to the same thing, the increasing of the average quality of output.

Problems Mainly in Southern Field.

Perhaps I should also say here that in dealing with the problems I will speak more from the standpoint of conditions in the southern iron fields. In the discussion of progress it has been necessary to consider mainly the industry depending on the Lake Superior ores, as it is here that most of our recent progress has been made. The Alabama district, on the other hand, is characterized not so much by past performances as by future possibilities, and has been repeatedly referred to as "that country where nature has done so much and man so little." It is true that there are a few very successful operations there, but when we consider the estimates of the geologists, that the ore reserves of this territory are some 50 per cent greater than those of the Lake Superior region, we can appreciate the fact that only the merest beginning has been made. To my mind Alabama today offers to the metallurgist, engineer, and capitalist the finest field in the whole United States for the exercise of their respective functions.

Distribution of Costs.

The percentage distribution of cost of making iron at northern and southern furnaces is about as follows:

	Northern.	Southern.
Ore	50 per cent	30 per cent
Flux	2 " "	2 " "
Fuel	32 " "	50 " "
Labor	8 " "	10 " "
Maintenance	4 " "	8 " "
	100 per cent	100 per cent

From these figures the great importance of fuel economy can be appreciated, and it is also evident that in the south particularly the greatest opportunities for saving are found in this direction.

As before noted, by means of the theory of critical heat we may predict and study the possible means of lessening fuel consumption with scientific accuracy. Considering only the heat reactions above the critical temperature, we may economize on fuel by reducing the heat required per pound of iron, and increasing the available heat per pound of coke.

Heat Required Per Pound of Iron.

In the first case, the heat required per pound of iron above the critical temperature may be classified as follows:

Fixed in quantity and not subject to reduction, the heat required for melting the iron.

Theoretically possible of improvement: Heat to melt slag, heat to decompose moisture, heat to reduce silicon, and heat required for several not well understood reactions, such as reduction of phosphorus and manganese, solution of carbon, etc.

Heat Supplied Per Pound of Coke.

The heat supplied per pound of coke above the critical temperature may be shown to be equal to the expression

$$H_t = H_c - H_m + h_b + h_c - (t \times w \times s)$$

Where

H_t = heat supplied per pound of coke.
H_c = heat of combustion of coke.
H_m = heat required to decompose moisture of blast.
h_b = sensible heat introduced in blast.
h_c = sensible heat introduced in coke.
t = critical temperature.
w = weight of gases.
s = specific heat of gases.

Of these factors, the heat of combustion of coke and the sensible heat introduced in coke are fixed quantities, while heat to decompose the moisture of the blast, weight of gases and critical temperatures are all theoretically capable of reduction, and the temperature of the blast is capable of increase.

These are the sources of saving in the hearth of a normally working furnace. In addition there is a loss of carbon in the upper part of the furnace due to the reaction.

$$CO_2 + C = 2CO,$$

which it is theoretically possible to to lessen. Also if the furnace works badly, is scaffolded, slips, is subject to water leaks, etc., extra fuel will be required, therefore fuel will be saved by regularity in running.

Recapitulation.

To recapitulate, the more promising lines for future work in fuel economy are as follows:

1. Smaller volume of slag.
2. Dry air for blast.
3. Lower silicon in iron.
4. Lower carbon in iron.
5. Increase in temperature of blast.
6. Decrease in weight of gases.
7. Decrease in critical temperature.
8. Decrease in carbon solution.
9. Increased regularity of working.

We will now discuss these in detail in their proper order.

Slag Volume.

The smallness of the volume of slag is practically regulated by the percentage of silica and alumina in the mixture, in which they occur principally in ore and coke ash. The problem, therefore, resolves itself into mining and concentrating methods, in the case of the ore, and into washing and coking methods in the case of the coke.

The development of magnetic concentrating methods is one possible solution of this problem. It has been already largely applied to the magnetic ores of the Alleghenies, and produces in some cases a concentrate as high as 70 per cent in metallic iron and with only 1 or 2 per cent of silica. These concentrated magnetites will undoubtedly find a much larger use in the future, as the Lake Superior ores become scarcer and higher in price. Magnetic concentration may also be applied to non-magnetic ores if these be first roasted, and it is along this line that there is the greatest room for improvement. Something has been done already, but the results while technically successful, were not commercially so, the costs being too high.

Coke Ash.

The importance of the fuel ash is less generally recognized than that of the purity of the ore, and yet in some districts it is of vital importance. At most points in Alabama, for example, from 30 to 40 per cent of the slag is due to ash of coke. Much of this appears unavoidable, but there is undoubtedly room for improvement in coal washing machinery, and particularly in coking methods.

In fact I believe that there is no other important manufacturing industry which will better repay a careful scientific study than coke making. The example of the by-product oven will occur to all, but even with the humble bee-hive oven, important economies are possible merely by the application of the commonest scientific principles, and the corrections of the gross carelessness customary at the average plant. For example, by poor judgment in the drafting of the ovens from 5 to 15 of fixed carbon is frequently unnecessarily burned, and the content of ash thereby increased from 1 to 3 per cent above that theoretically necessary. In one case of which I have personal knowledge, the supervision of a competent consulting chemist saved to an Alabama iron company in the neighborhood of $200 per day on the cost of the coke, and at the same time so improved its quality as to materially reduce the fuel consumption of the blast furnaces.

Limit to Slag Volume.

There is a lower limit beyond which we cannot carry slag volume on account of the necessity of carrying off the sulphur. This limit, of course, varies under every different set of conditions, and does not usually come into play except in the case of some of the purest of the Lake Superior ores, the remedy then being to add to the mixture a certain proportion of some more siliceous ore. The elimination of sulphur is influenced by a good many factors, some of the most important of which are: amount of sulphur present; quantity of slag; temperature of slag; composition of slag, including per cent of silica, alumina, lime, magnesia, manganese and alkalies. The quantitative, or even the relative effect of these different factors is almost entirely unknown today, and their investigation offers an attractive piece of work for the metallurgical chemist.

Dry Air Blast.

The importance of dry air blast has already been discussed, and I will only mention in passing that other methods of drying than refrigeration are possible, and may prove attractive problems. One method, which has been suggested but not yet tried, is to pass the air over fused calcium chloride, in suitable containers arranged in a similar manner to hot blast stoves. While one set of containers is drying the air, another set would be having its calcium chloride regenerated or dried by heating with furnace gas.

Lower Silicon in Iron.

Lower silicon requirements in the iron used by steel works has been an important factor in reducing fuel consumption in the past, and may be of some assistance in the future. The open-hearth process of steel making requires silicons ever lower than the Bessemer process, and with the rapidly increasing use of the open-hearth furnace our average silicons should also be lowered. It is also possible that the cheap electrical production of ferro-silicon may permit of the use of lower silicon irons in the foundry to an appreciable extent.

Lower Carbon in Iron.

So far, we know of no way of controlling the percentage of carbon in the product of our blast furnaces, nor do we know certainly just what effect its change produces on our fuel consumption. These are, therefore, problems for the future to solve, and it is hardly necessary to call attention to the fact that a lower carbon iron, if it could be economically made would be of interest to steel makers and foundrymen alike.

Increase in Temperature of Blast.

Preheating of the blast has been used for a great many years. The temperature ordinarily ranges from 800 to 1400 degrees Fahr. (or say 450 to 800 degrees Cent.) and is limited in some cases by the sticking of the furnace at the higher temperatures, and in others only by the amount of gas available or the ability of the stoves to stand the high temperatures.

The sticking or hanging occurs almost exclusively in furnaces using the fine Mesabi ores, when the blast heat is raised above a certain point, usually about 1,000 degrees Fahr. The cause is as yet rather obscure, and I do not think has ever been adequately explained. When the mechanism of the phenomenon is thoroughly understood we may possibly find a way to overcome it, and thus pave the way to fresh economy.

Efficiency of Hot Blast Stoves.

Where the heat now carried is limited only by the amount of gas available, our only alternative is to save on gas. The thermal efficiency of the hot blast stove is probably in the neighborhood of 75 per cent, and no doubt this can be considerably increased. But little attention has been directed to this phase of furnace efficiency, and there are practically no published data on the subject. The crying need here is for automatic recording instruments for composition and amount of gases passing to and from the stoves. When we have these figures we can tell what and where our losses are, and when we know our losses we can proceed to remedy them.

Gas Engines.

The largest saving in the line of gas economy is possible through the use of the gas engine. At present the majority of plants raise steam for blowing engines and other power requirements by the use of furnace gas as fuel, and it is only the excess of gas over this which can be spared for the stoves. Now as the large gas engine is considered to have some three times the thermal efficiency of the combined steam engine and boiler, it is evident that we can save here a very large amount of gas, and can if desired burn this in the stoves, thus raising the blast temperature. Actually, most plants, which have up to this time adopted gas blowing engines find it more profitable to convert this excess gas into power which is then sold to the steel mills.

The problems of the large unit gas engine are many, and offer an exceedingly attractive field for work. They are not all engineering as one might suppose, for the most important of all, the proper cleansing of the gas, belongs plainly to the chemical engineer. It is this problem which has delayed the introduction of the gas engine into blast furnace practice for so long, and though a fairly good solution has been reached in the use of centrifugal washers, yet it remains one of the most important questions before the profession.

Still another point which has been raised in connection with the obtaining of higher blast temperatures is the possibility of preheating the air used for combustion in the stoves. This could well be done by the use of the exhaust from the gas blowing engines, and a considerable gain in efficiency realized. The only difficulty would be in the design of equipment to accomplish this, which will be effi-

cient without being too costly or difficult to maintain.

Decrease in Weight of Gases.

Decrease in weight of gases is theoretically possible by means of increasing the concentration of the oxygen in the blast, or in other words, by eliminating part of the nitrogen. Today this is merely a dream of the future. Absolutely nothing has been done along this line, but it is an interesting possibility, and, unless in the meantime the electrical furnace entirely displaces the blast furnace, we may some day witness enormous combination plants, where iron is made with concentrated oxygen blast, while the residual nitrogen is converted into fertilizer.

Decrease in Critical Temperature.

It is theoretically quite possible to lower the critical temperature, and thereby make a large saving in fuel, by the use of a more fusible slag. Practically, however, the problem is not so simple, since the more fusible slags are as a rule siliceous or acid in their nature, and through their small affinity for sulphur, give a low grade of iron. Also the viscosity, or fluidity when molten must be considered. At the present time the whole question of fusibility of slags is enveloped in much obscurity. There are numerous data, but they are so widely scattered, unconnected, non-concordant, and many of them unreliable that they are of little practical use. The iron blast furnace slag consists essentially of lime-aluminum silicates, but contains in addition small percentages of alkalies, manganese oxide, ferrous oxide, and calcium sulphide, all of which exert effects, important, and yet but little understood. The lime also may be, and often is, in part replaced by magnesia. The effect of this upon the fusibility and affinity for the sulphur of the slag has been argued by furnacemen for a generation, but is today still uncertain. Laboratory experiments are needed to settle this and many other points, and the chemist who wil furnish these data will receive the gratitude of the furnace fraternity, and will have done much towards putting furnace practice on a more exact basis.

Decrease in Carbon Solution.

The waste of fuel through the reaction

$$C + CO_2 = 2CO$$

varies with four factors, viz., composition and temperature of gases, length of exposure, and physical structure of coke. The quantitative relations of these factors are unknown, but it is probable that the last is of the most importance from a practical standpoint. The composition and temperature of the gases will be favorably influenced by any change which increases the percentage of total heat available above the critical temperature. The time of exposure is decreased in the same way, and also in a very simple manner which is frequently overlooked, that is, by crushing the limestone. The smaller pieces of stone naturally give off their carbon dioxide at a lower temperature and higher in the furnace, whereby the waste of fuel is materially lessened. One of the most pressing needs of the blast furnace manager is a simple laboratory test for the relative solubility of cokes in carbon dioxide. It is generally recognized that there is an enormous difference in this respect, and this variation is reflected to some extent in the varying prices commanded by cokes from different districts or different veins of coal. A laboratory test such as I have suggested would enable consumers to buy coke on a rational basis, and would soon become absolutely indispensible to the trade.

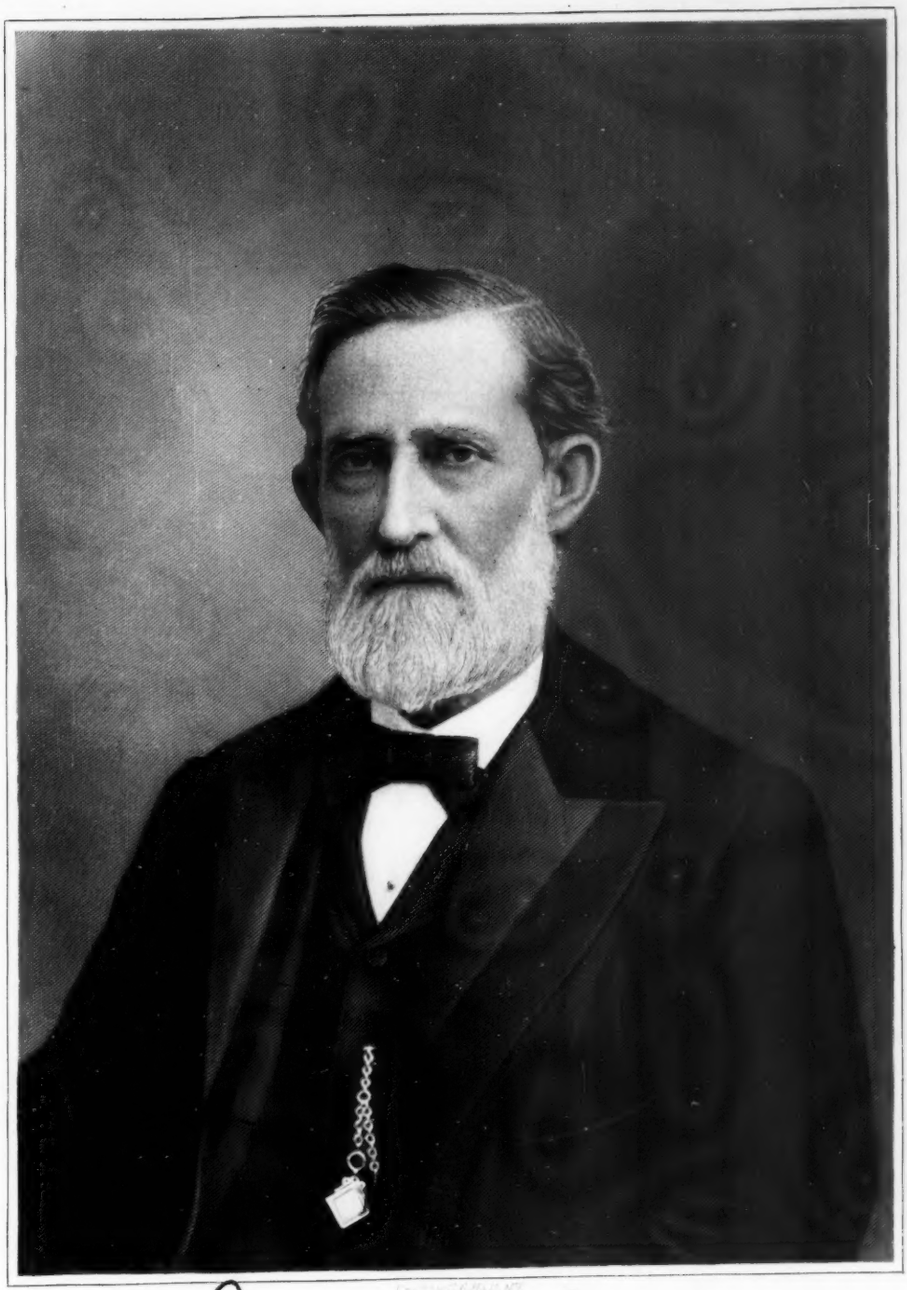
Conclusion.

In conclusion I wish to call attention to what is probably the greatest problem of all, the problem of securing proper management. If one goes out among furnacemen he will probably note that the majority are somewhat deficient in theoretical metallurgy. A considerable proportion have probably never heard of the theory of critical temperatures, and a good many of those that have will tell you to an accompaniment of weird expletives that it is just a fool theory and not worth a rap to the practical man. Very often, too, this man will be very successful as a furnace manager, while the theoretical man is quite as often a failure.

The cause for all this lies, not in the uselessness of theory as applied to the blast furnace, but in the fact that the duties of a furnace manager are threefold, that is, metallurgical, commercial, and executive. It is, of course, rare that these three accomplishments are developed to a high extent in any one man, and when they are the fortunate possessor of the talents soon takes a high position in the industrial world. The most promising solution of the difficulty is perhaps divided management, that is, a chief executive acting in co-operation with a metallurgical manager, who should have absolute authority on all questions of furnace work, and preferably also on mining and coking operations. This scheme has been tried in a few instances, and with most gratifying results. I have thought it worth while to speak of this, since it has been, is, and will always be a most important factor in the advancement of the technology of iron smelting.

LECTURE ON "PUDDLING" BY PROF. T. TURNER.

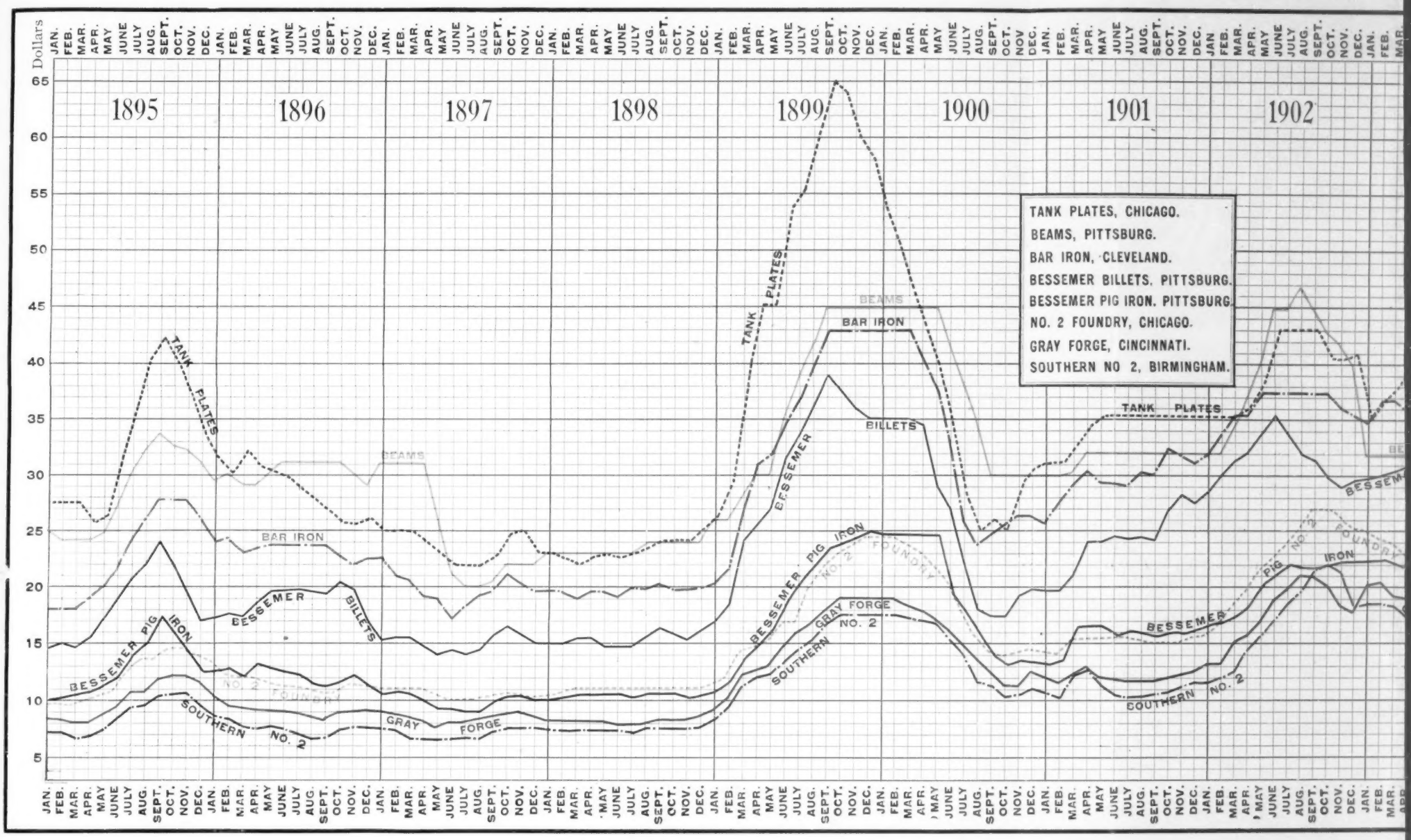
Prof. T. Turner recently delivered a lecture to the members of the Metallurgical Society, Birmingham, England, at the Technical School, on "Puddling." He recalled the fact that it was more than half a century since the Bessemer process was introduced the effect of which was to divide the iron trade into two camps, one of which predicted the failure of Bessemer and the other the extinction of puddling. Neither prophecy came true, because Bessemer had succeeded and puddling still remained an important industry in all the chief iron producing countries in the world. It was quite true that iron was becoming relatively less important as compared with steel year by year, but on the other hand extensions of wrought iron work and increases in the production of wrought iron were from time to time reported. Few districts suffered more severely as a result of the changes from iron to steel than South Staffordshire, which, when Bessemer came, was the chief center of the iron trade. But it was remarkable that the springing up of new industries in the district had replaced the former demand so that the population engaged in the iron trade was now larger and the workmen were more regularly employed than they were 40 years ago. Experience had demonstrated a superiority of wrought iron for roofing sheets, fencing wire, tin plates, galvanized sheets, and ships' fittings in cases where resistance to corrosion was more important than uniformity of finish. This had led to many orders which had once been lost coming back to an extent to the iron works. Puddling was essentially a British process, but mechanical puddling had been almost completely abandoned, though during the last two or three years renewed attempts had been made in this direction and with modern appliances for charging, drawing and rotating the furnace the chances of success were perhaps greater than previously.



James M. Swank

THE IRON TRADE REV

CHART SHOWING FLUCTUATIONS IN IRON AND STEEL P



AVERAGE MONTHLY PRICES OF IRON AND STEEL PRODUCT

(FINISHED PRODUCTS IN NET TONS. PIG IRON AND BILLETS IN GROSS TONS.)

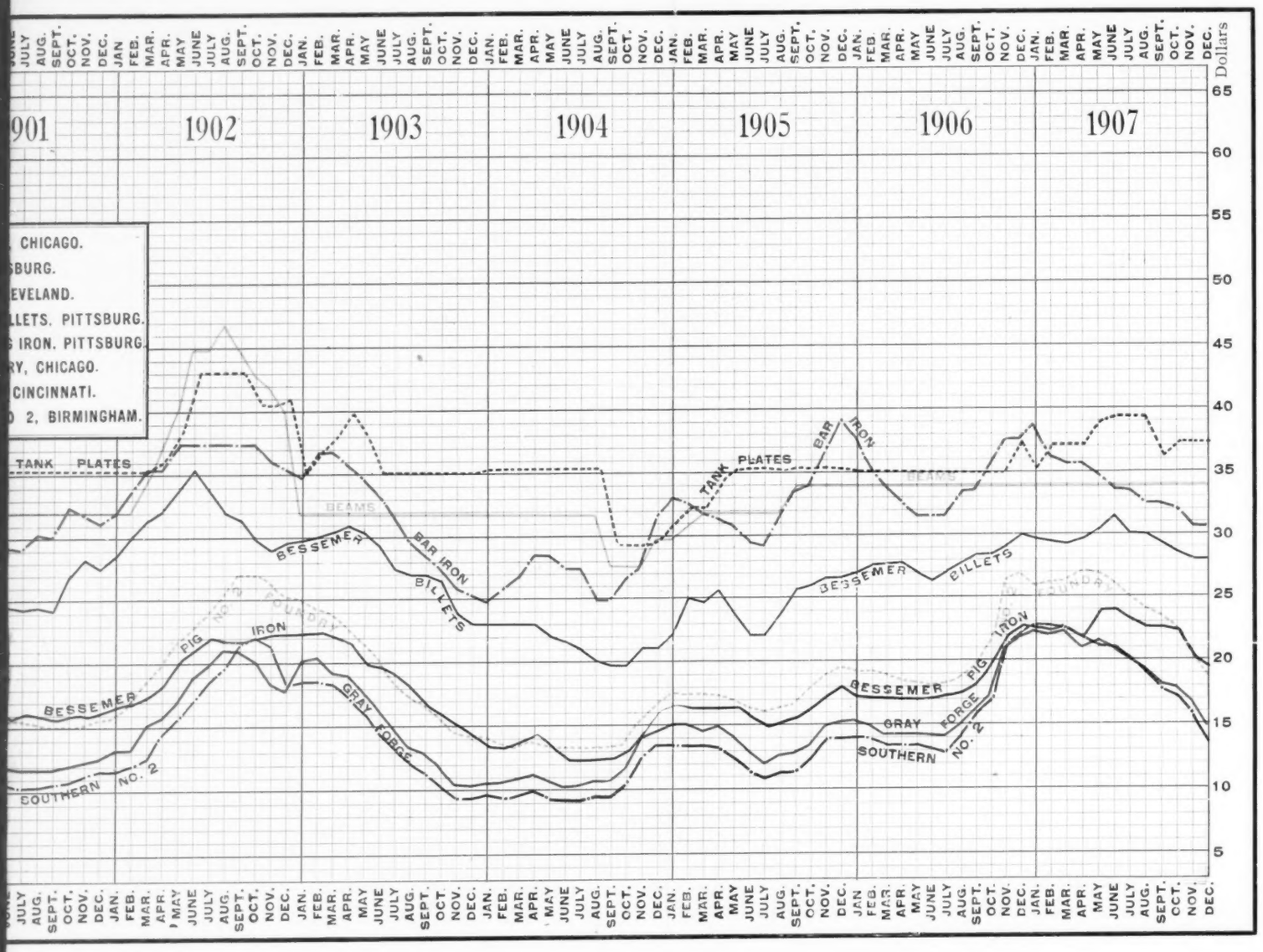
	1898												1899												1900											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.
No 2 Foundry Chicago...	$10 50	10 50	11.00	11.00	11 00	11.00	11.00	11.00	11.00	11 00	11.00	11.00	$11.25	12.00	14.25	15.00	15.25	17.00	17.00	20.00	22.00	23.00	23.50	24.50	$24.50	24.25	23.75	23.25	22.00	20.25	17.75	15.50	14.50	14.00	14.25	14.60	$14.9
Gray Forge Cincinnati...	$ 8.75	8.75	8.75	8.75	8.75	8.60	8.50	8.50	8.75	8.75	8.75	8.90	$ 9.50	10.50	12.75	13.00	13.25	15.00	16.25	17.00	18.50	19.25	19.25	19.25	$19.25	19.25	18.75	18.40	17.75	16.25	15.25	12.90	12.00	11.75	11.75	12.75	$12.2
Plates Chicago.....	$23.00	22.50	22 00	22.75	23.00	22.75	23.00	23.50	24.00	24.00	24.00	25.00	$25.50	29.50	39.00	45.00	45.00	53.50	55.50	60.50	65.00	64.00	60.00	58.00	$52.50	50.00	45.25	42.00	38.75	32.75	28.00	25.00	26.00	25.00	29.25	30.75	$31.0
Billets (Bess.) Pittsburg..	$15 00	15.00	15.25	15.25	14.85	14.75	14.75	15.45	16.10	15.75	15.25	16.00	$16.75	18.25	24.00	25.50	27.00	31.50	33.50	36.50	39.00	37.50	36.00	35.00	$35.00	35.00	35.00	34.50	29 00	27.25	22.50	18.00	17.50	17.50	19.30	19.75	$19.7
Bessemer Pig Pittsburg..	$ 9.90	10.15	10.40	10 50	10.40	10.40	10.35	10.40	10.40	10.30	10.20	10.65	$11.00	11.75	14.00	15.15	16.25	19.00	20.75	22.00	23.50	24.00	24.50	25.00	$24.90	24.90	24.90	24.90	24.90	19.75	18.00	16.05	14.00	13.25	13.65	13.55	$13.2
Beams Pittsburg.....	$23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.75	24.00	24.00	24.00	24.00	$26.00	26.00	28.00	30.00	30.00	35.00	38.75	41.25	45.00	45.00	45.00	45.00	$45.00	45.00	45.00	45.00	45.00	41.50	38.00	34.80	30.00	30.00	30.00	30.00	$30.0
Bar Iron Cleveland.....	$20.00	20.00	19.50	20.00	20.00	19.50	20.00	20.00	20.50	20.00	20.00	20.00	$20.50	21.75	27.50	31.00	32.00	34.75	36.75	39.75	43.00	43.00	43.00	43.00	$43.00	43.00	43.00	40.50	37 25	33 00	26.00	24.00	25.00	26.00	26.75	26.75	$25.8

	1903												1904												1905											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.
No. 2 Foundry Chicago..	$25.00	24.00	24.00	23.00	21.70	20.50	18.50	17.50	16.85	15.90	14.50	14.30	$14.10	13.75	13.55	14.00	13.80	13.40	13.30	13.35	13.40	13.70	15.60	16.60	$17.50	17.50	17.50	17.50	17.25	16.60	16.15	16.35	16.50	17.55	18.90	19.50	$19.2
Gray Forge Cincinnati...	$20.50	20.75	19.35	19.20	17.70	16.50	14.60	13.50	13.25	12.30	10.95	10.75	$11.00	11.00	11.25	11.75	11.25	10.75	10.75	11.00	11.00	11.75	14.25	15.00	$15.25	15.20	15.00	15.20	14.81	13.35	12.28	13.00	13.00	13.88	15.35	15.75	$15.7
Plates Chicago.....	$35.00	37.00	38.00	40.00	37.75	35.00	35.00	35.00	35.00	35.00	35.00	35.00	$35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	29.30	29.30	30.10	$31.30	32.30	32.30	34.80	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	$35.3
Billets (Bess.) Pittsburg..	$29.75	30.00	30.25	31.00	30.50	29.50	27.50	27.00	27.00	26.50	23.50	23.00	$23.00	23.00	23.00	23.00	22.00	21.50	21.00	20.00	19.50	19.50	21.00	21.00	$21.00	24.90	24.60	25.50	23.50	22.00	22.00	23.50	25.77	25.95	26.30	26.50	$27.0
Bessemer Pig Pittsburg..	$22.35	22.35	22.00	21.60	20.00	19.85	19.00	17.85	16.35	15.85	15.25	14.35	$13.60	13.35	13.85	14.10	13.60	12.60	12.50	12.65	12.75	13.35	15.25	16.60	$16.85	16.45	16.35	16.30	16.20	15.65	15.00	15.40	15.90	16.50	17.70	18.10	$17.3
Beams Pittsburg.....	$32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	$32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	28.00	28.00	28.00	30.00	$30.00	31.00	32.00	32.00	32.00	32.00	32.00	32.00	34.00	34.00	34.00	34.00	$34.0
Bar Iron Cleveland.....	$35.00	37.00	37.00	36.00	35.00	33.75	22.00	30.00	29.00	28.00	26.00	25.50	$25.00	26.00	27.00	29.00	29.00	28.00	28.00	25.00	25.00	27.00	28.00	32.00	$33.25	33.00	32.00	32.00	31.50	30.00	29.75	32.00	34.00	34.25	37.20	40.00	$38.0

SUPPLEMENT TO
THE IRON TRADE REVIEW
Jan. 2, 1908.

RADE REVIEW

AND STEEL PRICES FOR THIRTEEN YEARS.



N AND STEEL PRODUCTS, 1898-1907.

PIG IRON AND BILLETS IN GROSS TONS.)

1900

	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	.25	22.00	20.25	17.75	15.50	14.50	14.00	14.25	14 60
	.40	17.75	16.25	15.25	12.90	12.00	11.75	11.75	12.75
	.00	38.75	32.75	28.00	25.00	26.00	25.00	29.25	30.75
	.50	29.00	27.25	22.50	18.00	17.50	17.50	19.30	19.75
	.90	24.90	19.75	18.00	16.05	14.00	13.25	18.65	13.55
	.00	45.00	41.50	38.00	34.80	30.00	30.00	30.00	30.00
	.50	37 25	33 00	26.00	24.00	25.00	26.00	26 75	26.75

1901

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	$14.60	14.12	15.19	15.50	15.50	15.50	15.50	15.20	15.00	15.00	15.00	15.50
	$12.25	11.87	12.56	13.12	12.60	12 25	12.00	12.00	12.00	12.25	12.69	13.00
	$31.00	30.00	32.40	34.40	35.00	35 00	35.00	35.00	35.00	35.00	35.00	35.00
	$19.75	19.75	20.81	24.12	24.20	24.44	24.25	24.40	24.12	26.80	28.25	27.62
	$13.25	13.60	16.56	16.69	16.65	15.94	16.00	15.90	15.71	15.90	16.10	16.35
	$30.00	30.00	30.40	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00
	$25.80	27.80	29.30	30.80	29.80	29.80	29.40	30.80	30.60	32.80	32.00	31.70

1902

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	$15.80	16.75	18.62	19.75	21.75	22.50	23.40	24.66	27.15	27.15	26.90	25.40
	$13.75	13.75	15.25	16.00	17.05	18.93	20.00	21.50	21.50	20.60	18.87	18.00
	$35.00	35.00	35.25	36.25	38.60	43.00	43.00	43.00	43.00	40.60	40.50	41.00
	$28.06	29.81	31.37	32.25	33.90	35.18	33.50	32.12	31.50	29.80	29.00	29.25
	$16.70	16.93	17.56	18 37	20.95	21.25	22.00	21.75	21.75	21.95	22.25	22.12
	$32.00	32.00	34.00	37.00	40.00	45.00	45.00	47.00	45.00	43.00	42.00	40.00
	$32.10	33.70	35.70	35.77	37.70	37.70	37.70	37.70	37.70	37.70	37.50	36.20	35.70

1905

	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	.50	17.25	16.60	16.15	16.35	16.50	17.50	18.90	19.50
	.20	14.81	13.35	12.28	13.00	13.00	13.88	15.35	15.75
	.80	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30
	.50	23.50	22.00	22.00	23.50	25.77	25.95	26.30	26.50
	.30	16.20	15.65	15.00	15.40	15.90	16.50	17.70	18.10
	.00	32.00	32.00	32.00	32.00	34.00	34.00	34.00	34.00
	.00	31.50	30.00	29.75	32.00	34.00	34.25	37.20	40.00

1906

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	$19.25	19.25	19.00	18.75	18.50	18.10	18.30	18.90	19.75	21.50	21.50	27.00
	$15.75	15.4 5	14.85	14.75	14.75	14.65	14.55	15.40	16.50	17.50	21.70	22 00
	$35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	37.30
	$27.00	2 .50	27.65	27.75	27.00	26.25	27.00	28.00	28.50	28.50	29.00	29.75
	$17.32	17 29	17.26	17.25	17.24	7.38	17.57	17.96	18.44	20.06	21.96	22 75
	$34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00
	$38.00	35.50	34.00	33.00	32.00	32.00	32.00	33.50	34.00	36.00	39.00	39.00

1907

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	26.00	26.50	26.75	27 50	27 40	26.50	25.40	24.50	23.60	22.60	20.60	19.00
	$22 60	22.50	22.70	21.50	21.90	21.35	20.55	19.95	18.85	18.45	17.85	15.50
	$35.30	37 30	37.30	37.30	39.40	39.60	39.60	39.60	36.60	37.60	37.60	37.60
	$29.75	29.50	29.25	29.75	30.25	31.00	30.00	30.00	29.50	28.50	28.00	28.00
	$22.92	22.78	22.85	22 16	24 10	24 10	23.30	22.90	22 90	22.80	20.65	19.90
	$34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00
	$39.00	36.50	36.00	36.00	35.00	34 00	34.00	33.00	33.00	32 50	31.00	31.00

MODERN SYSTEMS OF HOISTING AND CONVEYING

By Walter G. Stephan.[1]

The business of hoisting and conveying has reached large proportions and has become specialized in many varied lines. A comprehensive review of this subject dealing with the problems of design would fill several volumes. Mr. Stephan has not attempted an article of this character, but has endeavored to point out, with the aid of photographs of actual installations, the many systems available and the special field of each. The manufacturer or engineer should be able, after a perusal of his review, to determine what system is best adapted to his needs.—Editor.

It is interesting to note the stages in the development of modern appliances for handling materials. Man's first hoist to aid him in lifting heavy weights was perhaps a wooden wedge which, driven between the weight and its support, raised it to the desired height. Or it may have been a wooden lever with his own weight as the lifting power. His first conveying machine was perhaps a wooden roller which was used in much the same way in which it is used today in places where modern machinery cannot be bought. The idea of a wedge gradually developed into the screw which is simply a long wedge or inclined plane, and the idea of a lever developed into the wheel and axle which is really a continuous lever.

Thus the screw jack was one of the pioneer hoisting machines, developed from the principle of the inclined plane, and still in use today doing capital work in places where nothing cheaper or more serviceable could be found. Further development of the wheel and axle resulted first in the ordinary block and tackle and then in the chain block, by means of which one man is able to lift a heavy load and hold it in place at any height.

Naturally those machines which were dependent upon man power for lifting the load, were supplanted after years of improvement by the air hoist, electric hoist, the electric traveling crane, etc. Each development came in response to the need for a machine to satisfy new conditions. Never in the history of the world has the improvement in hoisting and conveying machinery been more marked than it is today. The increased size of modern business enterprises and the consequent demand for machinery which will handle materials more economically and more rapidly have greatly stimulated the effects of manufacturers. So today while we still see the old style of hoist in its proper place, we also have a variety of new machines which are built to do special service.

[1]Consulting mechanical engineer, Citizens building, Cleveland.

The Differential Chain Block.

Referring to Fig. 1 we recognize the familiar chain block which taken by itself is adapted only to lifting and sustaining a load. With this particular block, one man can lift any load up to two tons. It is slow in operation, is light enough to be carried about by one man, is cheap and is simple in its construction and operation—an ordinary laborer can handle it with absolute safety.

Modifications of the simple differential block are now manufactured which makes it possible for one man to lift as much as 20 tons with ease, safety and more economy of power than can be claimed for the simple block. The fact that no locking device is necessary on the chain block is one of its great features, making it one of the safest lifting machines known.

The rig shown in the illustration consists of the ordinary portable tripod, which is set up over an opening into the basement, through which the generator castings are being lowered. What other mechanical device could be substituted for the chain block in the case illustrated which would handle the work as safely, as easily and as cheaply?

Fig. 1—Yale & Towne Chain Block.

In shops where the machinist himself has to handle the work to and from his machine, a chain block is hooked to a trolley mounted on a light bracket jib crane as shown in Fig. 2. This permits of a travel motion and a swinging motion in addition to the hoist of the chain block.

Where still further movement is required and where speedy hoisting and traveling is not essential, a chain block is hooked to a small four-wheeled trolley mounted on an I-beam traveling girder. See Fig. 3. This type is especially adapted to service in an engine room, electric power house or erecting shop where the service is infrequent, and where the cost of installation should be a minimum.

This installation is the simplest overhead traveling hand crane, having all of the movements of hoist, cross travel and longitudinal travel, and covering every foot of floor space between the overhead tracks. Some small machine shops have several of these cranes running parallel with each other between the posts—one in each wing, so that the entire floor space is covered by hoists. This makes a cheap and efficient installation in small shops where the amount or size of work done will not warrant power machines, and where speed is not essential.

A modification of the latter design is one in which the block is supplanted by an ordinary drum, geared to a pendant hand chain operated from the floor below. The cable on the drum leads to sheaves in the hoist block through which the load is lifted. Special designs provide for controlling all of the movements of hoist and trolley from one side of the crane, this style being applicable to use in small foundries where it is necessary that the operator be as far removed from the hot metal as possible, or to cases where the material handled is so large that the operator cannot stand close to the hook.

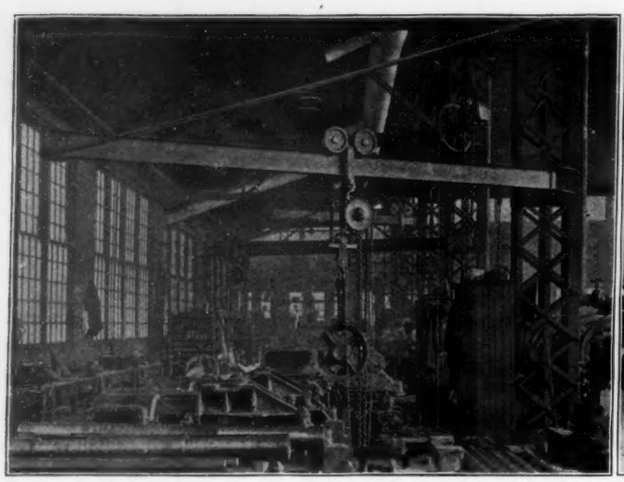


FIG. 2—BROWN HOIST CHAIN BLOCK ON JIB CRANE.

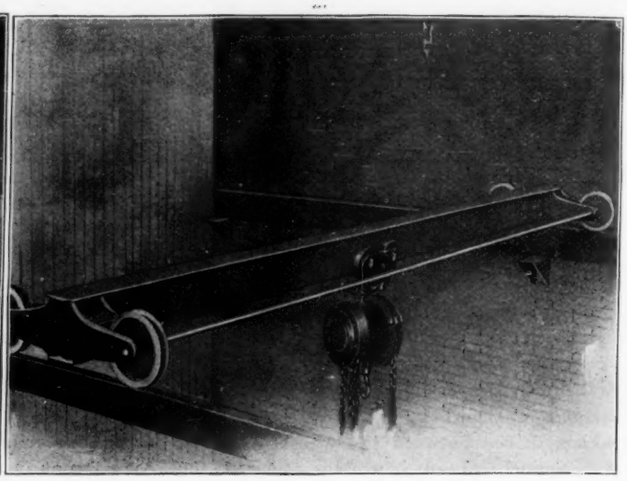


FIG. 3—BROWN HOIST CHAIN BLOCK ON I-BEAM TROLLEY.

In Fig. 4 is illustrated the hand power jib crane, common around foundries, machine shops and boiler shops. It is especially adapted to those conditions in large shops where frequent service is required within a given radius, and where one overhead traveling crane is not sufficient for the amount of work to be done. It is also especially adapted to the loading and unloading of material to and from cars or wagons, where bulky loads are to be lifted and moved only a few feet. In foundries it supplies a truly vertical lift for hoisting and lowering the cope from the flask which is essential, and being very simple in its construction it is unharmed by the dust and heat which is always present.

In shops where head room is very limited under the roof trusses, the jib crane proves to be the only solution to the problem of a hoisting machine. Two distinct forms of jibs are in common use. In one the horizontal arm is supported by an inclined strut running to the base of the column, and in the other, the horizontal arm is supported by tension rods or bars running to a point at the top of the extended column, which is trussed to support this point. See Fig. 5. The latter provides for a greater distance for trolleying the load while the former takes up less head room.

Where steam, air, or electric power is available, jib cranes are supplied with such power, in order to increase their speed and capacity. Ordinarily the power is only applied to the two movements of hoisting and trolleying but sometimes the swinging mechanism is driven by power as well. Fig. 5 illustrates the latter type, the power used in this case being steam. Where electric power is used separate motors are usually installed for the hoist and trolley motions, although one motor can be utilized for both movements by the use of clutches.

On a jib crane operated by air or water, the cylinder may be located at the base of the column or on the horizontal beam and back of the column. The power in these cases can only be used for hoisting purposes, and unless the crane is of fixed radius, the trolleying must be done by hand.

The Pillar Crane.

Closely allied to the jib crane is the pillar crane illustrated in Fig. 6. It is usually a hand driven machine and is especially serviceable for loading and unloading shipments at freight

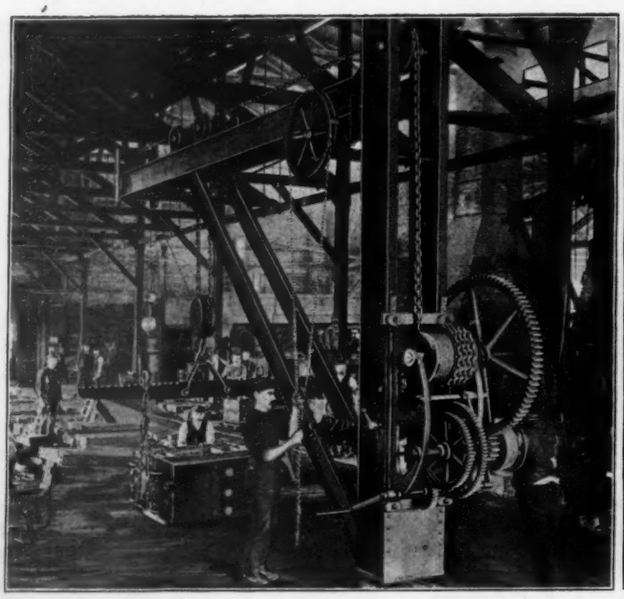


FIG. 4—BROWN HOIST HAND JIB CRANE.

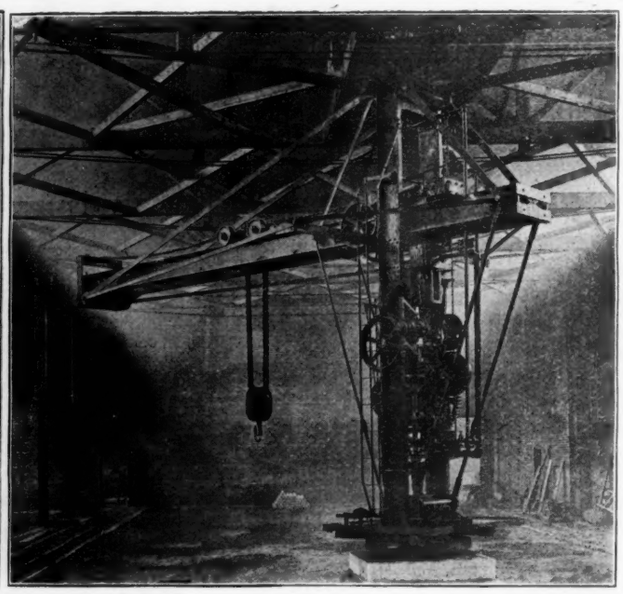


FIG. 5—BROWN HOIST POWER JIB CRANE.

depots. A heavy cast iron pillar with a broad base is securedly anchored to a masonry foundation and supports an inclined boom of fixed radius by means of tension bars fastened to a swivel casting at the top. Rollers at the foot of the boom merely rest against a ring at the base of the pillar. A winch mounted on the boom does the hoisting, while the swinging is done by hand. These cranes are sometimes driven by power, electricity usually being employed because of its adaptability. When mounted upon a railroad flat car it makes a most serviceable wrecking crane. If desired one can be mounted above each truck of the car and so double the efficiency and capacity. Hand cranes of this kind are made for capacities up to 25 tons.

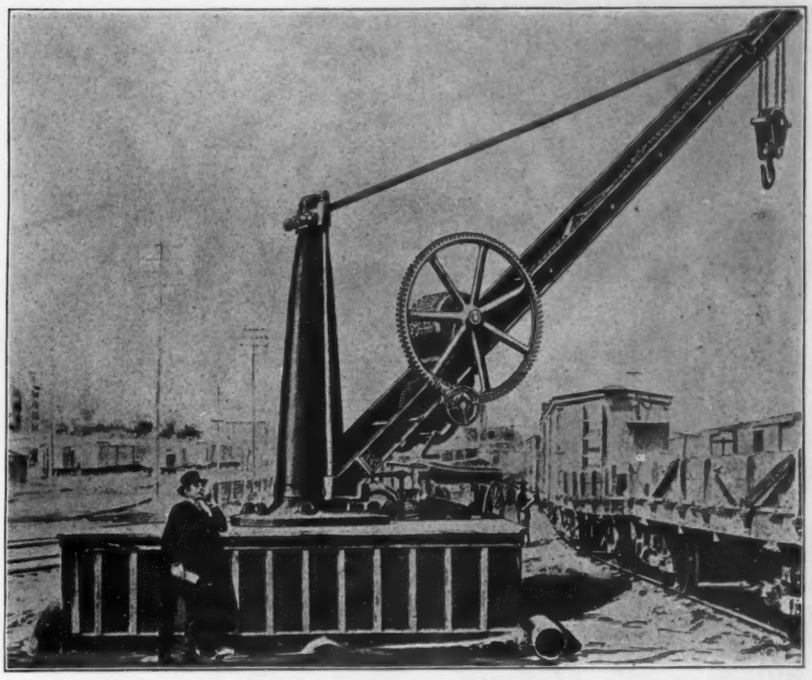


FIG. 6—BROWN HOIST HAND PILLAR CRANE.

The Locomotive Crane.

Mount a power pillar crane upon trucks, make it self-propelling and you have a locomotive crane, not a modern one to be sure, but a simple one. In the mind of the writer there is no tool in the shop world today which can excel the locomotive crane in usefulness.

It comprises the switching engine, the jib crane, the traveling crane and the derrick all in one, and its varied uses are too numerous to mention. It is the jack of all trades of the stock yard and the erecting shop. One man with this machine makes light work of the rapid handling of heavy, bulky materials to and from the shop and stock yard. He is his own engineer and fireman and though he requires one or two men to feed his machine with materials, the work which he performs is most economically done, and no work seems too heavy for him.

The locomotive crane is seen in the stock yards of structural shops, in railroad yards for repair work, and for switching, in power house service for transferring coal from stock pile to coal bunkers, in coal storage yards, in contractors' service where excavations are being made in lumber yards for handling heavy logs, in stone yards and in quarries and on ore docks for handling grab buckets for loading ore on to cars.

In Fig. 7 are illustrated two locomotive cranes in use on an excavation for a building. The cranes are loacted on temporary tracks laid along the edges of the excavation and their long booms swing the buckets down over the edge to the working level below where they are filled, then hoisted, swung around to the wagon in waiting and dumped. Fig. 8 illustrates the use of this style of crane in the yards of an iron and steel company, handling steel plates to and from the stock pile.

The locomotive crane is extensively used for wrecking purposes in which capacity it has no rival. It not only covers the area directly underneath the swinging boom but the hoist block can be carried down an embankment to the debris below and the wreckage can be hoisted up an incline to the track above. An excellent example of the modern heavy wrecking crane is shown in Fig. 9.

Steam is the usual motive power on locomotive cranes because it is an independent power which makes the crane entirely self-contained. However, some are electrically driven, the

FIG. 7—TWO BROWNING ENGINEERING CO. LOCOMOTIVE CRANES EXCAVATING FOR BUILDINGS.

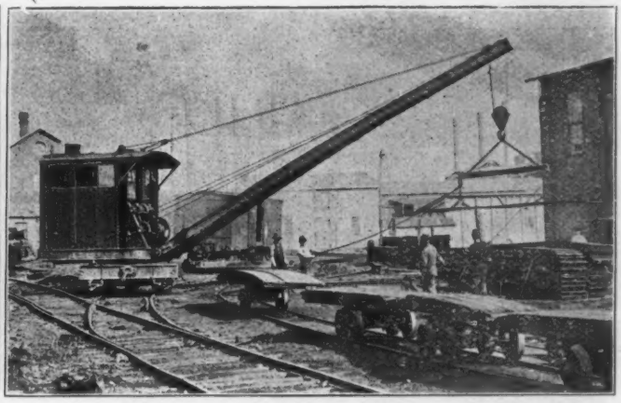


FIG. 8—BROWNING ENGINEERING CO. LOCOMOTIVE CRANE HANDLING PLATES.

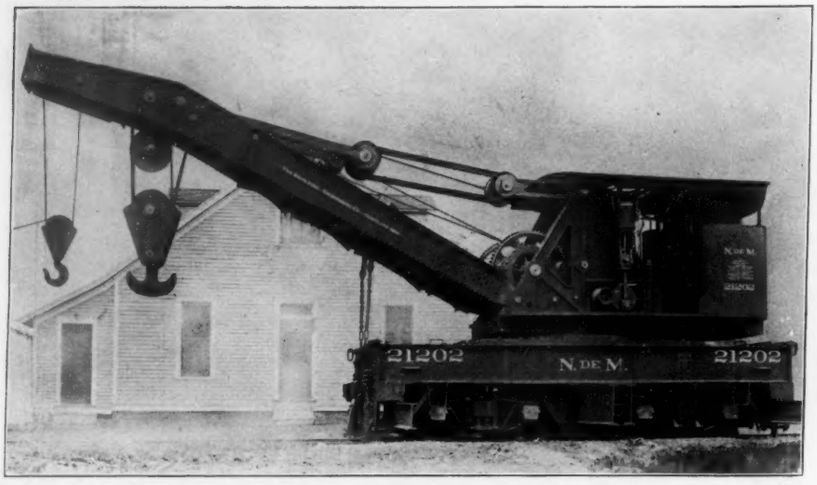


FIG. 9—BROWNING ENGINEERING CO. WRECKING CRANE.

trolley wires being located high enough to avoid all danger of interference from the swinging of the boom in its highest position.

The capacity of the locomotive crane varies from 3 tons to 20 tons, the hoisting speed from 25 to 135 feet per minute, and the travel along the track from 300 to 550 feet per minute under full load.

The Cantilever Crane.

The crane illustrated in Fig. 10 is especially adapted to the ship building industry. The great amount of territory which a machine of this class can cover on either side of the tower together with its great capacity and speed recommends it particularly for those conditions which prevail in the ship yard. The speed of hoisting varies from 100 to 200 feet per minute, the trolley travel from 1,000 to 1,500 feet per minute and the speed of the entire crane along the runway from 250 feet per minute to 750 feet per minute. In some stock yards such a cantilever crane is installed for handling structural iron, in which case the span is sufficient to cover an entire yard 300 to 400 feet in width. All of the movements of this immense machine are controlled by one operator who can handle the various movements with as much ease as the operator of an overhead electric traveling crane can handle his machine. The most successful cranes of this type are designed for minimum weight, to avoid unnecessary presentation of surface to wind pressure, owing to the exposed conditions under which such cranes must necessarily operate. No extra dead weight is carried on the trolley or bridge, thus permitting of the lightest construction consistent with strength and making it possible to start and stop the load very quickly. The cantilever crane stands out pre-eminently as the most successful crane for the use of the ship builder.

The Electric Overhead Traveling Crane.

The development of cranes for lifting and transporting heavy articles in the machine shop has been a marked feature of American industry and a surprising amount of money has been spent in introducting electric overhead traveling cranes, without which no modern shop equipment is complete. Their success has depended entirely upon the development of the electric motor, and dates from the time when the series-wound reversing motor was perfected. As shown by Fig. 11 they

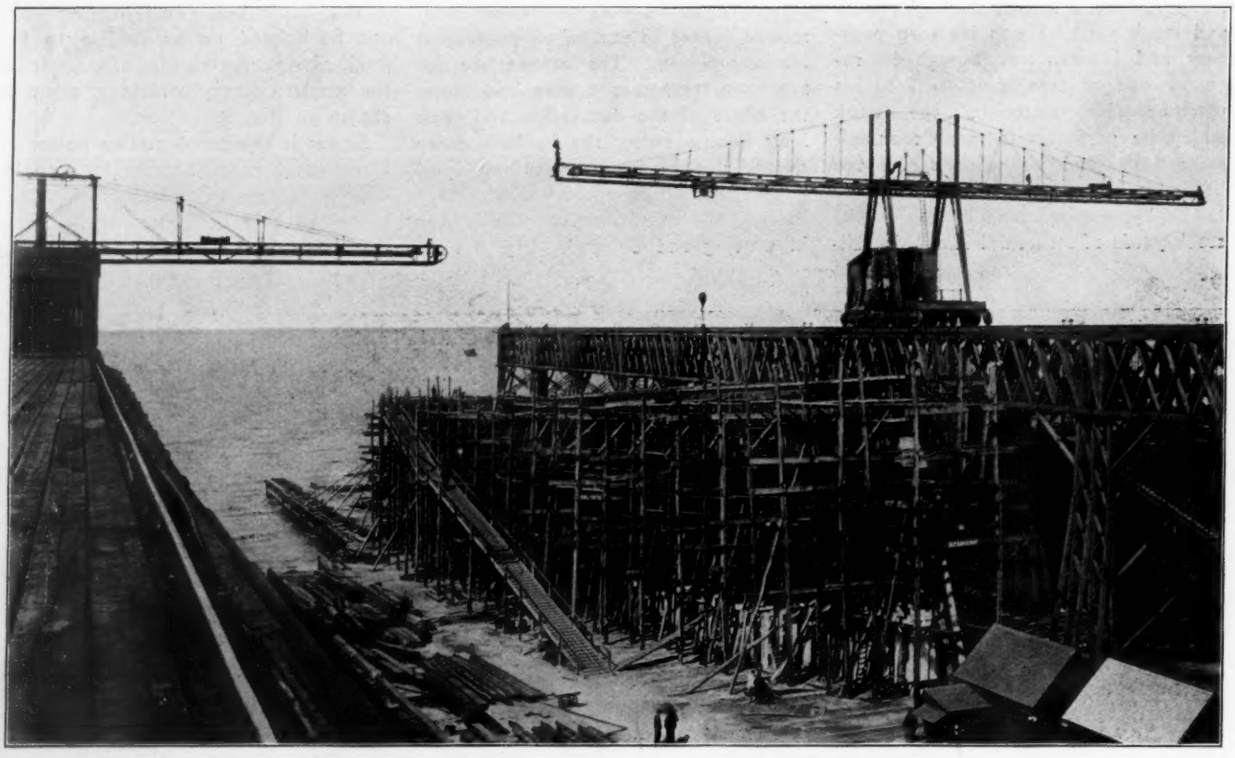


FIG. 10—BROWN HOIST CANTILEVER SHIP CRANE.

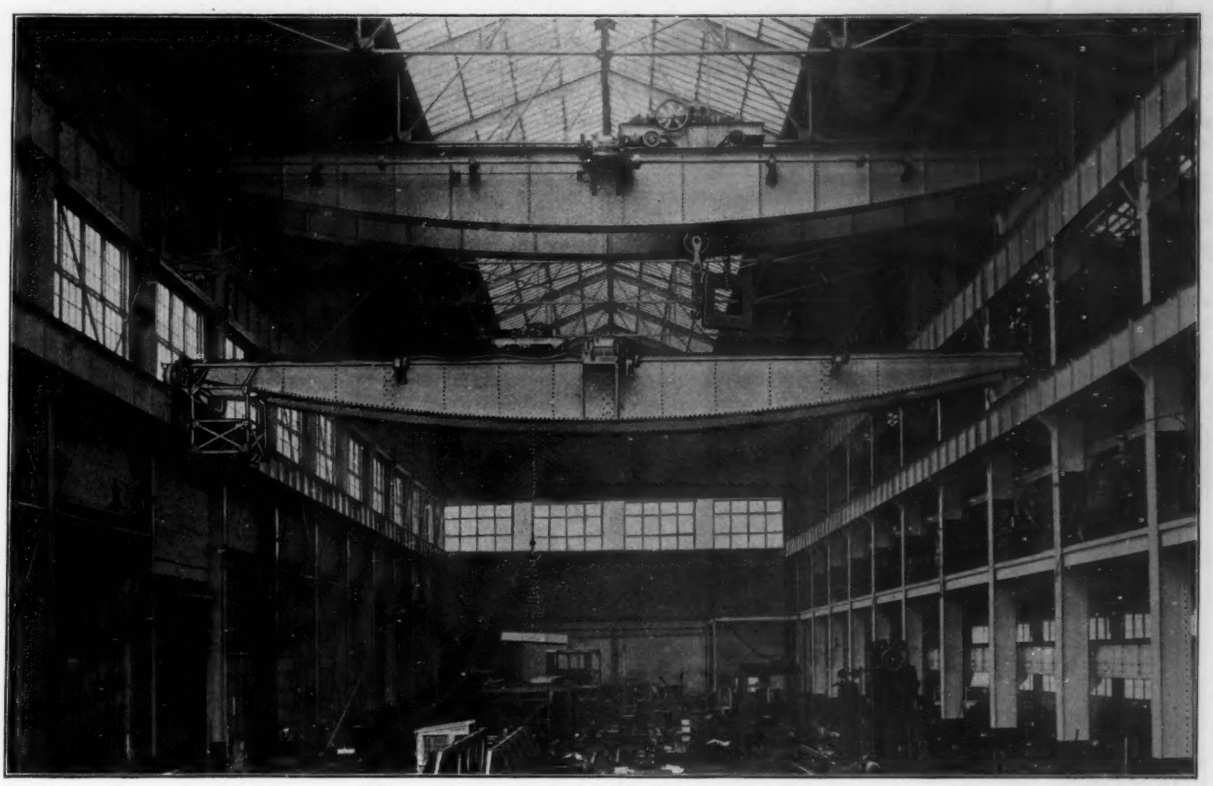


FIG. 11—ELECTRIC OVERHEAD TRAVELING CRANE—WELLMAN-SEAVER-MORGAN CO.

FIG. 12—TWO SHAW ELECTRIC CRANES HANDLING A LOCOMOTIVE.

consist of two heavy built up girders mounted on trucks at each end which travel on tracks supported on the columns of the shop building. Each girder supports a rail on which travels a trolley, from which hangs the hook or hook block for lifting the load. The operator is located in a cage at one end of the crane and controls all the movements by means of controllers located before him in the cage, with an accuracy and delicacy that is remarkable.

Above all things, such a crane must be perfectly safe, because heavy castings and frames are continually being handled over the heads of the workmen below. To meet this rigid demand all such cranes have a large factor of safety and are fitted with mechanical lowering brakes, as well as automatic electric motor brakes. The mechanical brake is a most ingenious device which sustains the load in case it starts to run down faster than the motor speed will allow.

The overhead crane is adapted to any situation where a large area in a building or stock yard is to be served. In machine shops there is usually one crane of large capacity covering the main erecting floor. In larger shops where very heavy materials are handled often, a second crane is mounted on tracks above the first, thus permitting each to travel the entire length of the runway at all times as shown in Fig. 11. When heavy girders or long heavy materials of any kind are to be handled, one end is hooked to the lower crane and the other to the upper crane. Fig. 12 shows two cranes handling a locomotive in a locomotive shop, in this case both cranes being mounted on the same tracks.

In some instances the building is constructed with an open end and the tracks supporting the crane are extended beyond the building so that the crane can be used in loading and unloading cars from railroad tracks outside.

In stock yards, a series of such cranes are mounted on parallel overhead tracks as shown in Fig. 13. Naturally such an installation is only permissible where great quantities of structural steel are handled continuously as for instance in large manufacturing steel plants.

The E. O. T. crane finds special applications in foundries and rolling mills, where large ladles of hot metal are to be handled. The operator is located in a cage at considerable distance from the hot metal and travels with the load. Sometimes the cage is extended down vertically to a point just clearing the charging or pouring floor, thus bringing the man almost on a level with his work.

Fig. 14 illustrates a double trolley ladle crane in use at a steel plant.

The hoisting speed of standard E. O. T. cranes varies from 10 on the heavier to 50 feet per minute on the lighter types, and the longitudinal speed varies from 150 to 350 feet per minute under full load. Their capacities range from 5 ton to 100 tons.

The Air Hoist.

The simplest style of compressed air hoist is the single cylinder type illustrated in Figs. 15-17. It consists of a cast iron or brass cylinder with piston and rod to the lower end of which is fastened a hook. It is simple in operation and very quick acting, being suitable for short lifts of comparatively light loads, where head room is not a premium. It is a serviceable hoist in the foundry and structural shop where compressed air is needed also for chippers and riveters and where each gang of workmen requires light lifting service. The modern hoist of this kind is made safe and fool proof by means of automatic stops to prevent overhoist and safety checks so that an ordinary laborer can operate it without danger, by means of the two pendant chains one for hoisting and one for lowering. Where head room is small the cylin-

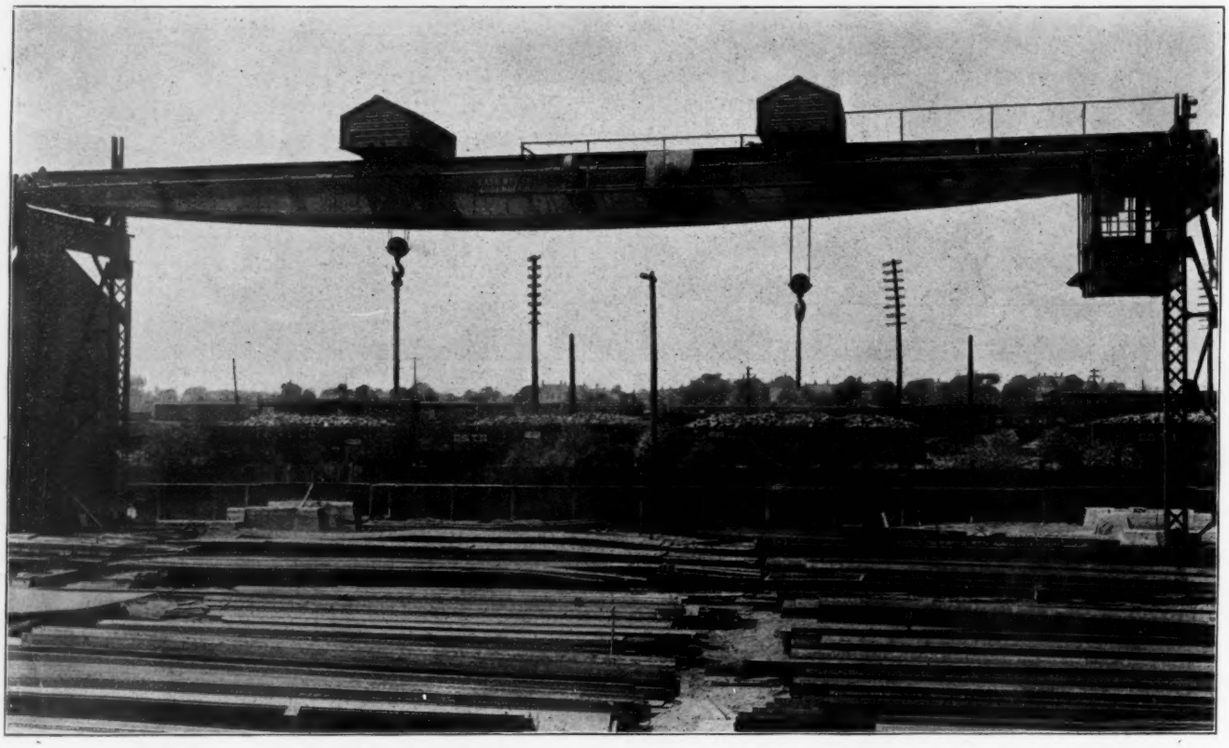


FIG. 13—CASE CRANE HANDLING STRUCTURAL MATERIAL IN STOCK YARD.

der is sometimes mounted permanently on the side wall of the foundry and a cable from the piston rod is led over a sheave and across to a trolley running on tracks above the shop. The cable runs over two sheaves on the trolley and around a sheave block below, being finally anchored to the opposite wall of the building. Still another installation to save head room consists of an air cylinder mounted horizontally on a traveling carriage as shown in Fig. 16, which shows an air hoist lifting ice cans in an artificial ice plant, where it would be impossible to install a vertical cylinder on account of the small head room.

The normal lifting capacity of the cylinder type of air hoist varies from 350 pounds to 20,000 pounds, although they are made to handle as high as 40,000 pounds, in which case the cylinder is excessively large.

The pneumatic motor hoist illustrated in Fig. 18 shows its application to the handling of structural work out of doors. Wherever riveting is to be done, compressed air is always necessary and can be used to great advantage for hoisting purposes. The motor hoist is designed especially for longer lifts than can be conveniently arranged for with an air cylinder. It consists of a grooved drum which is geared to an air motor, the entire arrangement being very compact and self-contained, and supported from a swiveling hook above. The cable from the drum leads down to a sheave block below, and as many parts of cable are used as may be necessary for the particular capacity and lift required. Like all hoists of this kind which are used out of doors and are not usually attended by skilled mechanics the mechanism is protected from injury through carelessness or lack of attention.

The Electric Hoist.

The electric hoist which is a comparatively recent development in the field of hoisting and conveying machinery and which is now out of the experimental stage is fast growing in popular favor and bids fair to invade the field of all cranes. It has a bright future before it, with innumerable opportunities for adapting itself to special conditions. One of the most important developments has been the use of these hoists to convert old hand cranes into efficient up-to-date power cranes. The installation of course involves slight alterations in the old parts, but the total cost of the change is very small compared with the expense which would be necessary for installing an entirely new electric crane. Speaking generally it consists of a cast frame suspended either from a hook or hung from a small trolley, in which is mounted a chain or cable drum, driven by a series wound motor through a train of gears.

A controller is located right on the frame and is operated by means of cords reaching to the floor. The entire machine in its simplest form is very compact and all parts are well protected from dust and injury. Where the simple hoist is stationary, current is supplied by wires leading directly to the hoist from the supporting frame. Where the hoist is mounted on a trolley the current is supplied by two trolley wires running parallel to the supporting beam and fastened to it. Fig. 19 represents an electric hoist of small capacity which can be mounted on a trolley running on an I-beam track. The striking features of this design are its compactness and the small amount of head room which it occupies. It makes a convenient hoist with which to serve machine tools where comparatively light loads are to be handled.

For such purpose it is mounted on a light bracket jib crane. It is very simple to operate, the hoisting being accomplished by pulling on the starting cord, a limit switch being provided to prevent an over hoist and which cuts out the current before any damage can be done. An automatic brake prevents the load from dropping and sets, as soon as the current

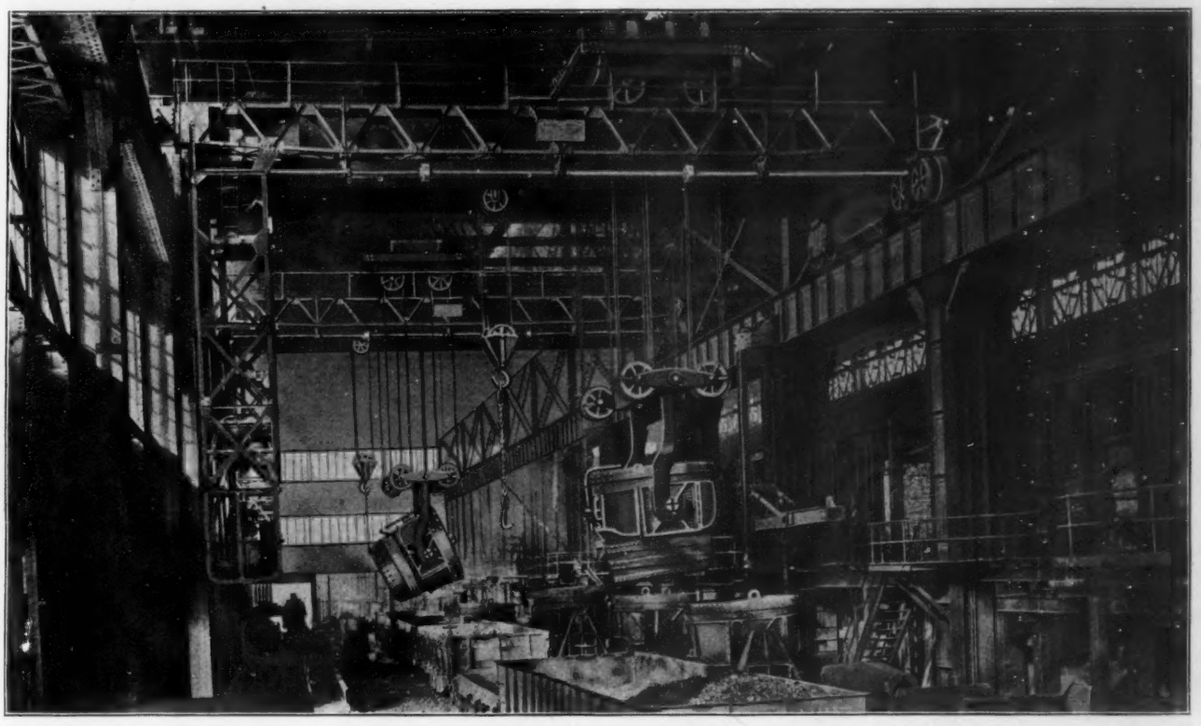


FIG. 14—WELLMAN-SEAVER-MORGAN CO.—DOUBLE TROLLEY LADLE CRANE.

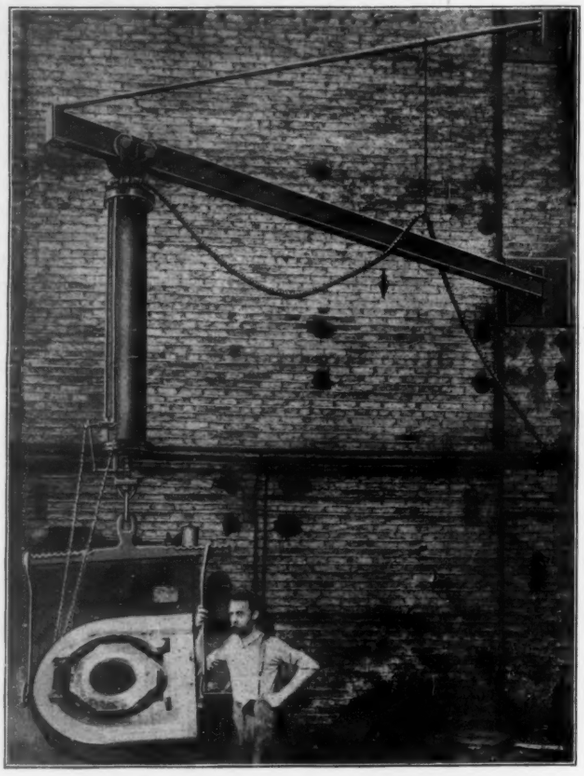


FIG. 15—WHITING AIR HOIST IN FOUNDRY.

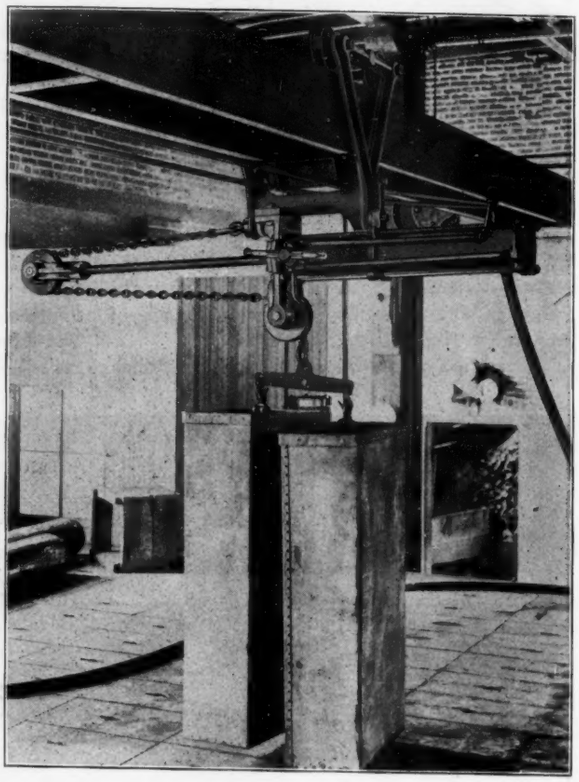


FIG. 16—WHITING AIR HOIST—HORIZONTAL CYLINDER TYPE.

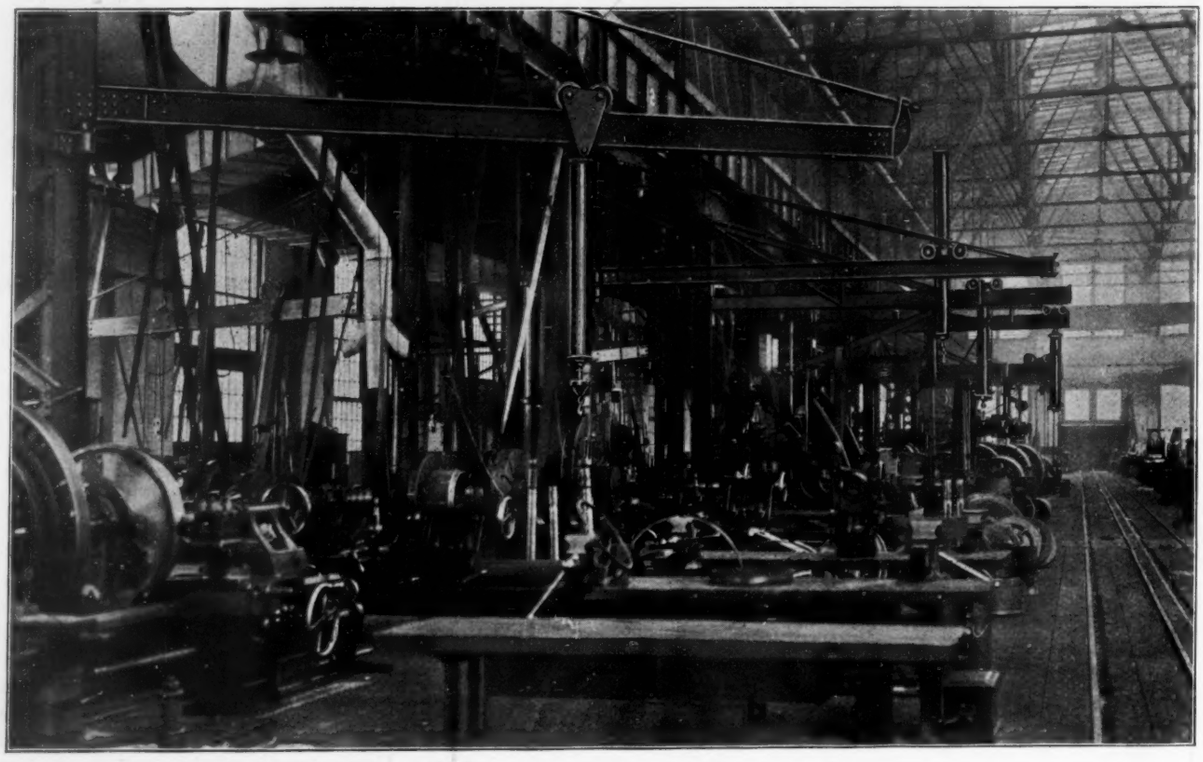


FIG. 17—WHITING AIR HOIST IN MACHINE SHOP.

is cut out. The movement back and forth on the track is accomplished by hand pressure applied to the load.

Where it is desired to carry a load of more than 2 or 3 tons to some distant point in the shop, the electric hoist is mounted on driving trucks which travel on tracks above. These tracks can either be the flanges of one single I-beam or two beams or channels side by side. Naturally the operator must travel with the load and when the path of travel is over piles of castings or uneven ground, a light cage is provided for him, suspended from the frame above. In the cage are located the controllers for handling all of the movements of the hoist. When the path of travel is such that the operator can easily follow the load, the trolley wheels are geared to a motor controlled also by pendant cords as shown in Fig. 20.

For serving machines in a machine shop an installation similar to that shown in Fig. 21 affords quick, easily controlled lifts which help to increase the capacity of the shop. In this case the hoist is suspended from a hook on a small trolley running along the beam of a jib crane. This hook suspension permits of a slightly inclined lift.

The photograph, Fig. 22, represents the modern electric traveling trolley with cage for the operator.

The single I-beam track can be arranged in an endless variety of ways; spur tracks can be run out by means of switches to any remote building or yard. The track can be curved so as to run completely around the shop in which case the trolley must be provided with swiveling trucks. The system is a very flexible one, adapting itself to almost any conditions and nothing could be cheaper to construct, even in an old building, than an I-beam track, suspended from the roof trusses or girders.

A very complete system of crane trolleys and electric hoists for a shop is shown by the plan and elevation Fig. 23. The central portion of the shop is provided with an overhead electric traveling trolley mounted on an I-beam bridge running the entire length of the building and out through the end for loading and unloading cars at the west side. It is in fact an electric traveling crane. This trolley can be run off onto another bridge over the north wing, or it can be run onto the spur tracks of the south wing, one of which runs to another building in the same plant. Spur tracks are also run across the south wing and over the siding at the south side of the building for loading and unloading at this point. Thus the electric trolley with its load can be run to any part of the works by means of this transfer system which can be extended at will.

The transfer bridges are operated by separate motors controlled from the operator's cage below, and safety stops are provided on bridge and spur tracks to prevent the trolley from running off the track. These trolleys are designed for capacities ranging from 2 to 10 tons. In the elevation is shown an installation of electric hoists in the north and south wings. In the north wing are two electric hoists in the north and south wings. and in the south wing are two hoists mounted on parallel I-beam tracks running lengthwise of the stop.

Fig. 24 shows an electric traveling trolley mounted on a transfer crane and capable of being run out onto spur tracks at various points in the shop.

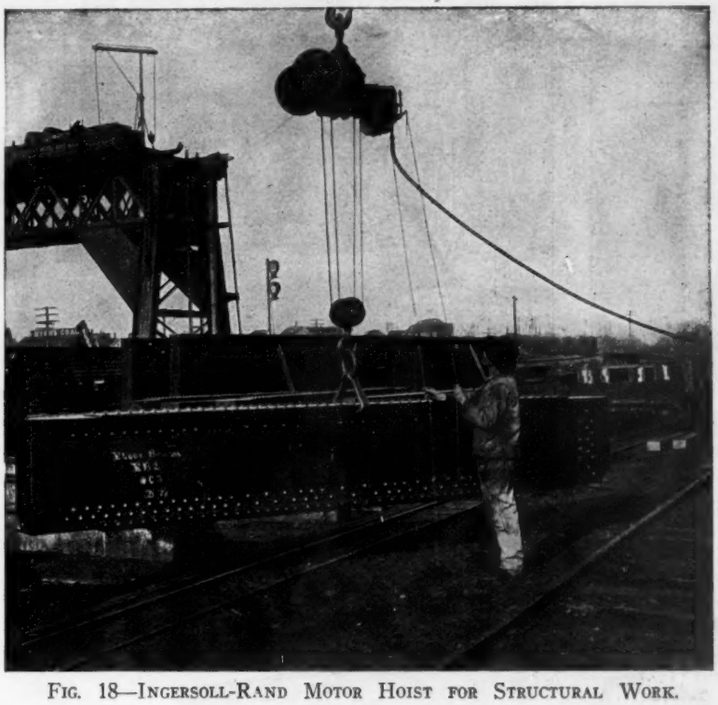


FIG. 18—INGERSOLL-RAND MOTOR HOIST FOR STRUCTURAL WORK.

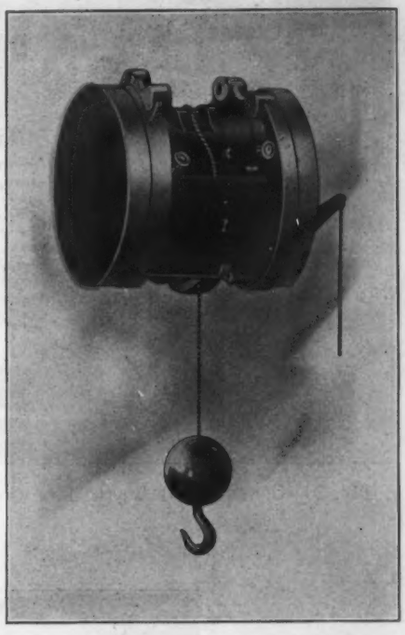


FIG. 19—SPRAGUE ELECTRIC HALF-TON HOIST.

Lifting Magnets.

The use of the electric magnet for handling materials is another development of recent years which has attracted widespread attention. The field which this magnet covers is one in which the material to be handled is steel or iron such as cannot be taken hold of easily either by chain or by hook, or which otherwise has to be handled very expensively by hand. Such materials comprise first of all steel plate which have always been troublesome to handle, scrap iron around furnaces, pig iron, slabs, blooms, etc. Fig. 25 illustrates a novel use for the magnet in which pig iron is lifted directly from the sand in a blast furnace cast house. Fig. 26 shows a magnet used in raising a safe and

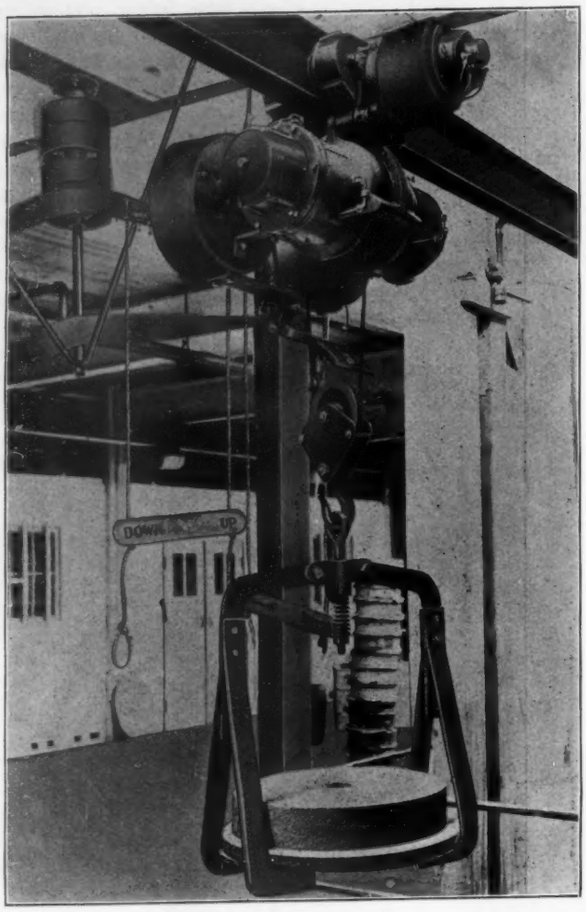


FIG. 20—GENERAL PNEUMATIC TOOL CO. ELECTRIC HOIST.

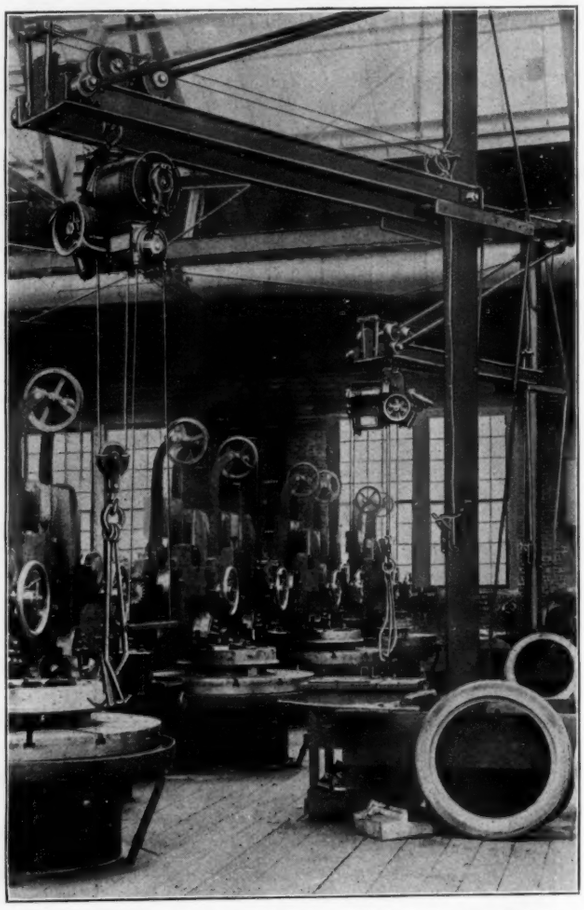


FIG. 21—YALE & TOWNE ELECTRIC HOIST ON JIB CRANE.

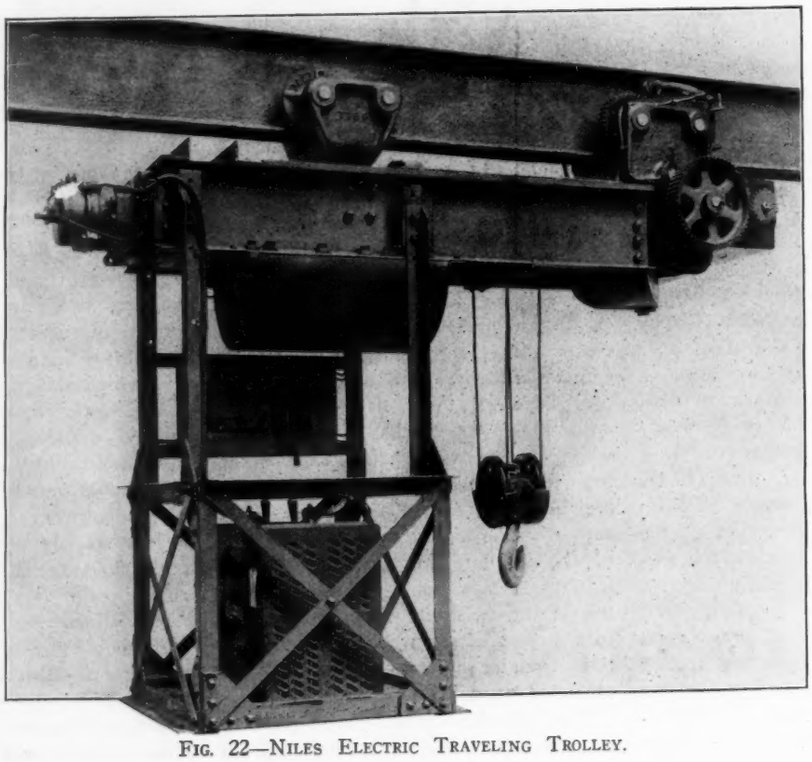


FIG. 22—NILES ELECTRIC TRAVELING TROLLEY.

transferring it to another part of the works. In both cases the magnet is fastened to the hook block of a traveling crane which does the hoisting and conveying, the magnet simpling acting as a holding medium.

Belt and Chain Conveyors.

The continuous economical handling of material has been made possible by chain and belt conveyors. No system of cranes or hoists can compete with them in their particular field. They have a monopoly of certain lines of work. Their great features are: First, simplicity of construction, a very few parts comprising the entire system; second, great capacity; third, economy both of power and of head room; fourth, cleanliness in the handling of certain classes of material. They are a development of the idea of the division of labor, which is such a vital feature in the economy of American manufacturing methods. The conveyor accomplishes one single operation and only one. It runs continuously in one direction, there are no reversals of direction, no clutches, brakes, etc., with their consequent loss of efficiency. The loads per foot of length are not heavy and are evenly distributed permitting of very light construction throughout and yet the hourly capacity is very large.

Briefly described the belt conveyor consists of a continuous belt driven by a driving pulley at one end and running over a tail pulley at the other end, with supporting rollers between. The belt may be rubber or canvas, and

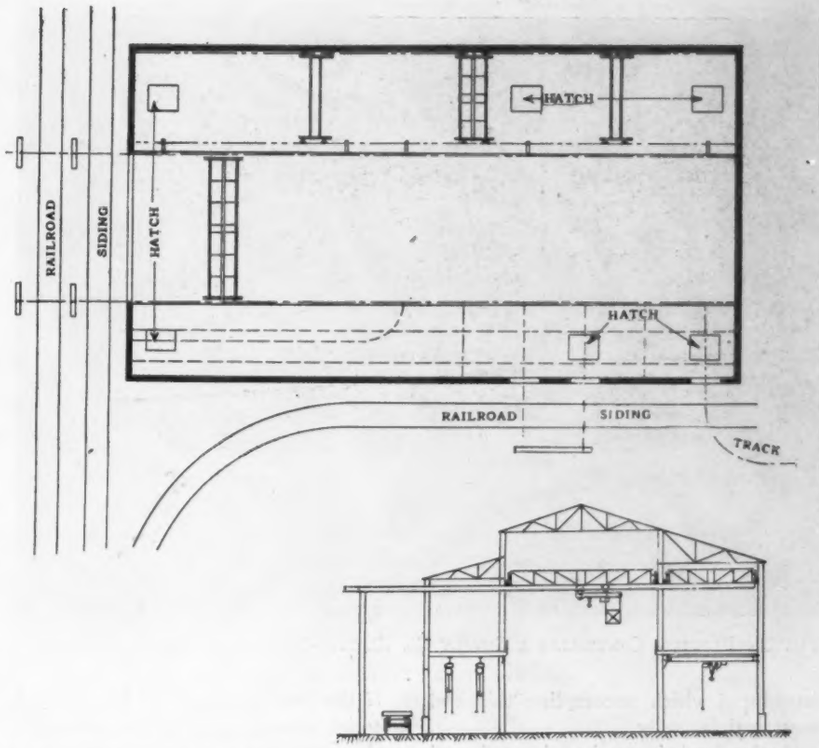


FIG. 23—PLAN AND ELEVATION OF MACHINE SHOP EQUIPPED WITH NILES-BEMENT-POND CO. HOISTS.

can either be troughed or flat. It ranges in width from 6 inches to 72 inches.

Belt conveyors are particularly well suited to the handling of coal, ore, grain, sand, pulp, etc. Where these materials are fed onto the belt in a continuous stream, the quantity handled in one day is surprisingly large, and where the driving power is variable this capacity can be greatly increased by simply running the belt at greater speed, and feeding more material. The scope of this article will hardly permit of more than the mere mention of the use of the conveyor for handling coal, ore, etc., but its use in the handling of merchandise, lumber, ice, etc., will be dealt with more in detail.

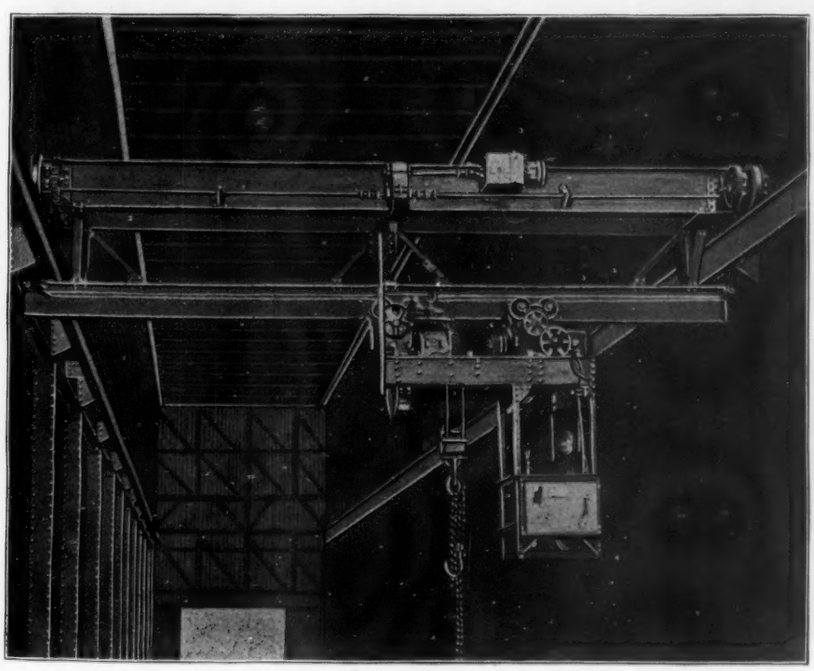


FIG. 24—CASE ELECTRIC TRAVELING TROLLEY ON TRANSFER CRANE.

Many situations have developed in the manufacturing world in which the product of manufacture is to be transported continuously either from one part of the mill to another for further treatment or the finished product is to be carried to the warehouse for storage or to the shipping department for final disposal. The conveyor is the ideal solution of such a problem and adapts itself to the numerous and varied conditions.

If the material is to be carried along on one floor for a distance and then raised up to the next, the conveyor is made level for the required distance and then curved up gradually to an inclination which will bring the discharge to the required spot. Or the horizontal conveyor can be stopped at a given point, where it unloads its burden onto a vertical bucket or inclined belt conveyor which discharges at the proper level. If the load is to be evenly distributed along a given path, automatic tripping carriages are

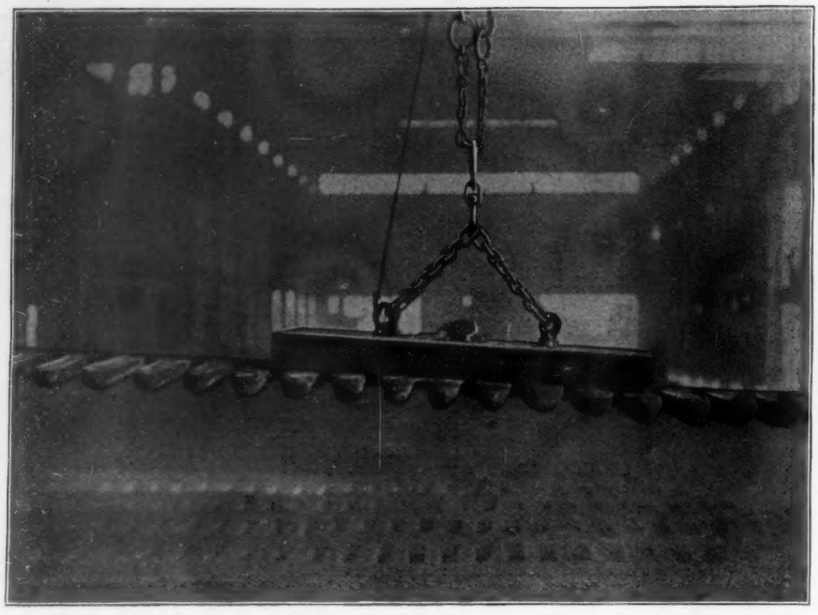


FIG. 25—ELECTRIC CONTROLLER & SUPPLY CO. ELECTRO-MAGNET HANDLING PIG IRON.

introduced which accomplish this end most satisfactorily.

If the load is to be elevated and conveyed at the same time, the conveyer is simply inclined at the proper angle, which angle in the case of belt conveyors cannot exceed about 27 degrees from the horizontal.

If the load is simply to be elevated, a series of inclined belts are arranged, each succeeding belt receiving its load from the one next proceeding, and in its turn depositing its load through chutes to the next belt above.

The chain conveyor consists of one or more endless chains driven by sprocket wheels at one end, and having buckets, dogs, pans, lugs or carriers of various shapes fastened to them at regular intervals. These carriers are either shapes which are fastened to special links in the chains, or the special links themselves have carrying lugs cast on them for conveying purposes. The path of the chains is limited either by a trough or by light tracks on which travel supporting rollers which are a part of the chain.

The few illustrations shown will merely indicate the great variety of uses to which these conveyors can be put.

Fig 27 illustrates a belt conveyor which is used to handle sacks of merchandise up an incline into the warehouse. The simplicity of the construction and the carrying capacity under such conditions is clearly shown. Fig. 28 is a chain conveyor which is used to handle cakes of manufactured ice from the manufacturing plant to the storage house. It consists of a single heavy flat link chain traveling in the middle of a flat wooden trough. At regular intervals of 10 feet are special links with attachments and projecting dogs which carry the ice along the trough to its destination. This conveyor travels at a speed of 75 feet

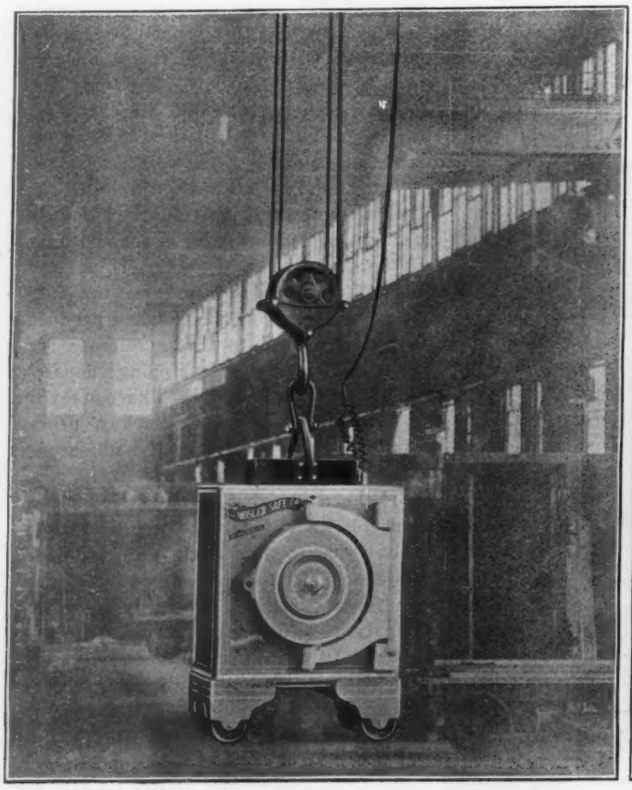


FIG. 26—ELECTRIC CONTROLLER & SUPPLY CO. ELECTRO-MAGNET HANDLING STEEL SAFE.

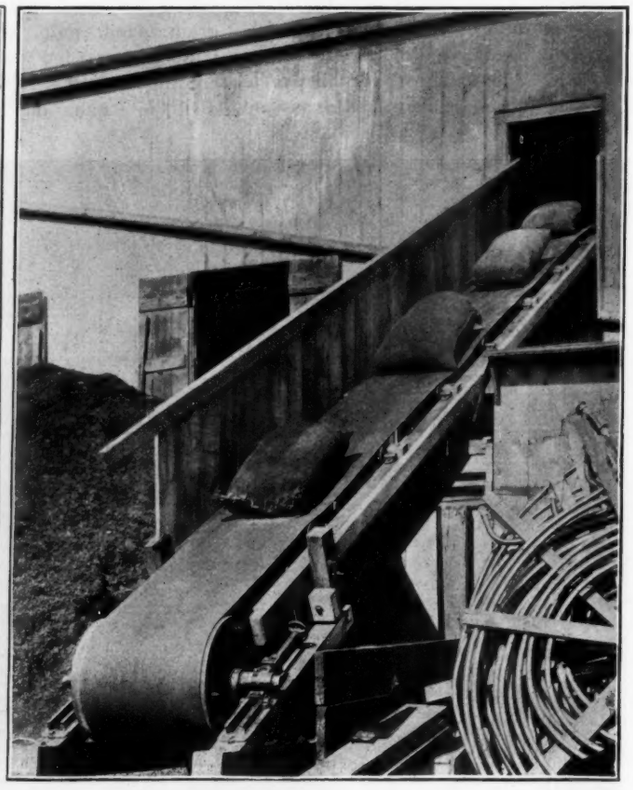


FIG. 27—JEFFREY BAG CONVEYOR.

per minute and handles 450 cakes of ice per hour. A very interesting installation is shown in Fig. 29. Here a wire rope conveyor, 435 feet centers, is supported on a simple suspension bridge which spans the river underneath. The wire rope has short wooden cross bars fastened to it at intervals which act both as guides for the conveyor and as carriers for the lumber.

One of the most difficult things to handle easily is a log out of water. Fig. 30 will illustrate the modern method of handling logs from the water to the saw mill. The conveyor consists of one single extra heavy cable chain having special links with sharpened dogs spaced regularly. The chain travels in the bottom of a heavy wooden V-shaped trough and extends under the water at the lower end so that the man at the water's edge simply guides the log onto the lower end of the conveyor where the dogs bite into the wood and carry the log to the top of the incline and along the platform—a distance of about 500 feet.

A conveyor which will handle 20,000 brick per hour certainly commands attention. Such a conveyor is the one shown in Fig. 31 which is used to carry brick from the kiln to the stock yard. The conveyor is supported by rollers running on a flat bar track. These rollers are also the support for each special brick basket which is so designed that the center of gravity of its load of five brick is directly under the track.

The speed of travel of the conveyor is about 200 feet per minute and the carriers are spaced about three feet apart.

FIG. 28—JEFFREY ICE CONVEYOR.

Cableways.

In building dams, or constructing long walls, breakwaters, canals, etc., nothing can replace the horizontal cableway which is illustrated in Fig. 32. It consists of a heavy steel cable

FIG. 29—JEFFREY LUMBER CONVEYOR ON SUSPENSION BRIDGE.

FIG. 30—JEFFREY LOG CONVEYOR.

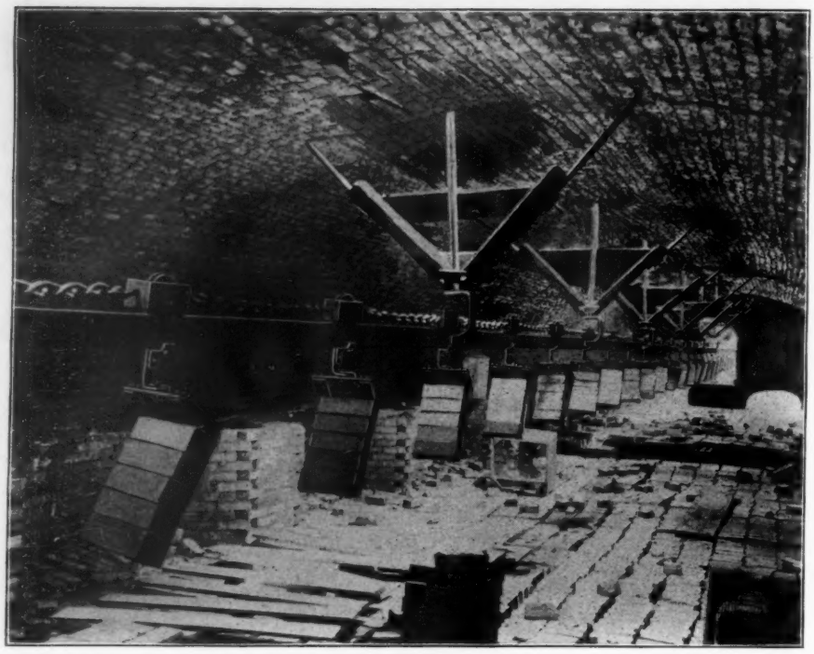


FIG. 31—BARNEY BRICK CONVEYOR—JEFFREY MFG. CO.

suspended between two movable or stationary towers and carrying a traveling carriage. This carriage is operated by means of several small cables which propel it along the cableway and also hoist the load either in skips, buckets or on chains. Any kind of material can be handled at any point along the line, and the carriage is under such excellent control that the skilled operator can lay cut stone with ease. Loads up to 15 tons are handled.

A very recent design in cableways is the balanced cable crane illustrated in Fig. 33. The cable is suspended between two inclined oscillating shears pivoted on a single inclined rail at the base. Counterweights attached to the top of the shears take the place of rigid anchors. The weight of cable, car and load is held in equilibrium by the counterweights. The operator travels on the load carriage which is self propelling and has a hoisting drum under his control.

FIG. 32—LIDGERWOOD CABLEWAY.

POWER SERVICE IN THE FOUNDRY.*

BY A. D. WILLIAMS JR.

In view of the progress that has been made in other mechanical lines, it is remarkable that the foundry of today remains much as it was in the past. Since it plays a most important part in the industrial economy of all metal manufacturing plants, either directly or indirectly, it merits better treatment than it has received.

Some years ago the chemists turned their attention to the foundry and the results are seen in the replacement of empirical by scientific methods of mixing and melting and in the heat treatment of castings. The concrete results of their experiments are apparent in a reduction of the percentage of castings lost and the production of castings better suited to the purpose for which they were made.

Recent Progress.

The mechanical end of the foundry offers an interesting field for the engineer, not only in the designing of the castings, but in the invention of ways and means suited for their production. To a degree this work has been started, but has been confined to the production of molding machines and appliances, and the greatest progress has been made in those foundries which are devoted entirely to special lines of work, in which large quantities of castings of the same or similar characteristics are turned out. In the foundry whose output comprises a large variety of castings ranging from bench work to heavy housings and bed plates, the methods in use today differ but slightly from those of 20 years ago, the improved facilities consisting mainly in the provision of a better crane service for handling the work.

Lack of Power Equipment.

The principal reason why power is not used to a larger degree in foundry work arises from the fact that few foundries are so designed that the means at hand can be used to the greatest advantage. Machine molding is limited in its applicability to castings which can be turned out in sufficient quantities to justify fitting up for them. Power can be used for nearly all classes of green sand work, and once the proper fixtures for its use are available it will be found of service in many ways. The foundry crane of today is a vast improvement over that used in the past, but in the matter of improved crane service, not

*A paper presented at the New York (December, 1907) meeting of the American Society of Mechanical Engineers.

only the foundry but the machine shops as well, suffer a diminished output per square foot of floor area. Molding machines, cranes, chipping chisels, grinders, the blower and the cupola elevator are the usual limit of power service in the foundry. A few columns, roof trusses and siding, a crane with its runway, possibly a few jib cranes, a cupola with its charging platform, elevator and blower, some core ovens and a little industrial track are dumped down in a vacant lot and called a foundry. A rough neck carpenter knocks a few flasks together and sand is spread on the floor; just as soon as some pig iron, limestone and coke, etc., are delivered the plant is in running order. The machine shop is usually very carefully designed.

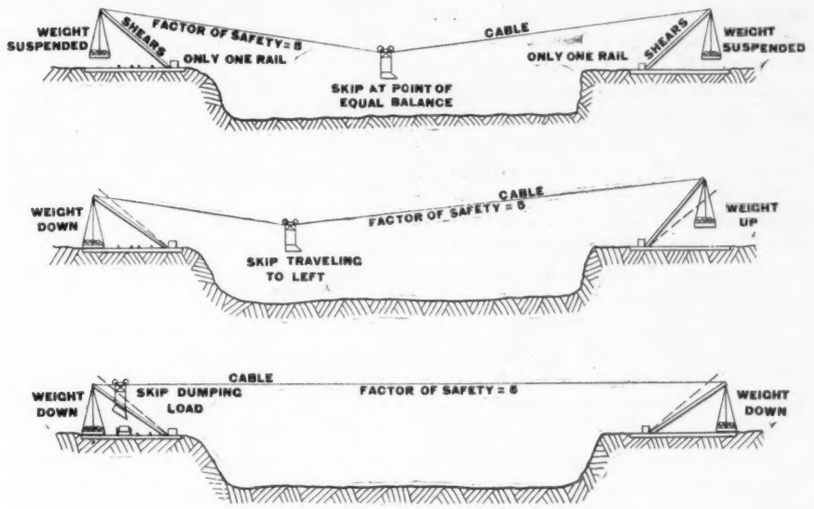


FIG. 33—DIAGRAM OF BALANCED CABLE CRANE.

Crane Service.

The crane service of a foundry is its vital point. There must be crane capacity to handle the heaviest piece to be made, but at the same time it is necessary to bear in mind the fact that there are a number of medium and a greater number of light pieces, to be turned out for each heavy casting. A single crane can serve only one floor at a time; the others must wait, in fact two or three floors are often waiting on the crane and must take their turns after the crane has finished handling a load of less than 1-60 of its capacity. This scene is not uncommon in the foundry, and that they were "waiting for the crane" is often the excuse for molds left over for the next heat.

The bridge traveling crane is a most useful machine but it cannot be in two places at the same time and as yet no successful method has been devised by which two of them can pass each other either on the same or on different levels, in fact the use of bridge traveling cranes on two levels only adds to the expense and does not supply any advantages over those cases where all of the bridge cranes are on the same level. The jib crane is limited in usefulness as it cannot serve floors outside of its radius, but a number of light column jib cranes, arranged so that they can be set up and transported from place to place as needed, are very serviceable. This can be accomplished by placing permanent pintle bearings on a number of the columns and by designing the jib cranes so that they can be handled from point to point. The traveling wall crane affords the most satisfactory method of increasing the crane service without interfering with the bridge travelers above, and the column jib cranes below its level.

Electrical Appliances.

The electric motor offers the most satisfactory method of operating hoisting machinery. This arises from the convenience with which electricity can be delivered to these machines by means of sliding contacts. A further advantage lies in the close control of the movement which is essential to the gentle handling and accurate placing on the molding floor; another distinct advantage of the electric hoist is its ability to hold the load stationary for an indefinite time.

High hoisting speeds are undesirable, in fact the tendency is to get the hoisting speeds too fast in most shop cranes, high speeds being of service only in the handling of bulk materials and package freight. In the foundry a speed of 10 feet per minute with full load is ample for heavy work and speeds exceeding 20 feet per minute are sufficient for the lighter hoists. Positive and uniform motion is necessary in handling copes and the sudden start of the ordinary air hoist spoils a great many molds. This sudden start occasionally occurs with electrically operated hoists having an improperly designed controller.

Motors.

There are a number of good makes of electric motors on the market and some that are not so good. A first class standard motor is desirable, and in equipping a plant it is better to have all of the motors of one make, particularly those of the same size. A little attention to this point will greatly reduce the amount of money it is necessary to invest in spare parts. By a standard motor is meant one which has been made on manufacturing lines in large numbers. In addition to these there are a number of concerns building special motors more or less suited to their special requirements. The designers of such motors are handicapped by the fact that they are not able to avail themselves of the experience gained in the manufacture of a large and varied line. The street railway type of motor frame, or one which is split on an angle, having two poles or one pole in each portion of the frame, is the most desirable, owing to the facility with which it can be opened up in cramped places for changing armatures or for other repairs. These motors are of the enclosed type and have been developed to work under conditions which would discourage the ordinary machine. The manufacturers of these motors often style them as "very rugged" which is an insult to the workmanship and designing ability which has developed these desirable types of machines. Another feature of such motors is the method of lubrication, in which the car box journal has been studied and improved. Lubrication is often neglected by careless operatives and while any machine is better for a little attention, these motors will stand up under poor conditions.

Compressed Air.

Molding machines are generally operated by compressed air, but hydraulic power is used with some machines. Compressed air is elastic and this is a disadvantage for many operations, as any alteration in the load causes a corresponding change in the position of the actuating plunger or piston. Some compressed ain hoists have been designed with a governor device that regulates their speed of action, but it is impossible to avoid

troubles due to the elasticity of the air. Another disadvantage of compressed air machines is the large size of the hose connection required, which is more troublesome to care for than the smaller flexible connection to an electric motor. Compressed air however is very useful in cleaning out pockets in molds and for power ramming machines; for the latter it presents the only successful driving power. These machines are not as widely used as they might be, and where it is desirable to avoid the long air hose connection, a portable motor-driven air compressor can be used. The bellows and torch, for blowing out and skin drying the sand, can be avoided, the former by using the air hose with special nozzles, the latter by arranging some sort of a heating device close to the air hose nozzle. An electric heating device might be serviceable for this purpose.

Distribution of Compressed Air.

As generally installed, with a central compressing plant, the use of compressed air requires an expensive transmission line and in addition, it is impossible to avoid leakage in the joints. Compressed air leakage does not show, and the pipe lines for this purpose, as usually constructed, are designed to remain tight only long enough to pass the acceptance test. Leakage is a continual drain on the system, and shows up in the amount of coal consumed. Except in the large sizes, air compressors are steam eaters like steam pumps; for this reason the small electric driven air compressor presents numerous advantages, as it consumes no power when out of use and, if portable, avoids the long pipe line. The disadvantages of long air lines are well illustrated by the fact that in some of the big excavating contracts it has been found very advantageous to install a steam driven electric generating station at a point where fuel was available from a railroad siding, and transmit electric power to the compressor station located on the work, thus avoiding the losses of a long pipe line or fuel haulage.

Hydraulic Power.

Hydraulic power is but rarely used in the foundry. It has advantages for some lines of work. Water being non-elastic, comparatively speaking, it supplies a positive pressure, and while the hydraulic machine can be stalled, it is impossible to break it by legitimate methods, when it is properly designed. The pressures carried in hydraulic systems range around 500 and 1,000 pounds per square inch; where higher pressures are required in certain machines they are obtained by the use of intensifiers. The most serious disadvantage of hydraulic service systems occurs only where swinging joints are required to convey the pressure and waste water to and from moving machines, as cranes, etc. In the machines themselves the glands are like all other glands, troublesome to maintain, and are often pulled up so tightly that they greatly reduce the efficiency. The controlling valves also give a certain amount of trouble. The most of the trouble with hydraulic systems arises from the use of dirty, gritty water. An illustration of the advantages of using a clean fluid occurs in the hydraulic wheel presses in which the same fluid is used over and over again; these machines cause very little trouble from leaky glands. High pressure hydraulic systems are however expensive to install, and it is extremely probable that the best method of utilizing hydraulic power will be to use an electrically driven pressure pump with its accumulator installed close to the floor upon which hydraulic molding machines are to be used. This would reduce the required amount of pressure and waste line to a minimum. Necessarily this small hydraulic plant could not be placed in the foundry itself but a small pump room would be a requisite.

Steam.

Steam power was at one time the only motive force available and was either transmitted to those places in the foundry where it was required by means of belts and shafts, or small engines were used, driving the different machines by belts. In some cases small gas or other explosion motors are used in a manner similar to the early steam motors. Owing to the fact that small engines are not economical and have several other disadvantages which are familiar to all who are posted on foundry operating conditions they are not considered as desirable as other kinds of motors. The steam hydraulic crane and elevator, both of which operate on the same principle, are two of the most satisfactory machines devised for foundry service, because they are very simple and for that reason it is practically impossible for the most careless operator to damage them, except by the most studied neglect. One of the bad features of any transmission system which deals with moist elements such as water, steam and sometimes compressed air, exists in their liability to damage in cold weather by freezing. This danger has to be very carefully guarded against in temperate and cold climates, during the night and on all occasions when work is interrupted. To guard against this trouble some form of heat insulation is required.

Selection of Power.

As to which is the best power to adopt, depends in a large degree upon the local conditions affecting the plant, and by studying such conditions much better results can be attained than are possible by off-hand decisions. A harmonious installation works more smoothly than a miscellaneous assortment and, in addition, the design should take into account the future growth as a possibility, this matter being often left out and resulting in endless complications when extensions have to be made. Because the largest part of foundry power requirements are intermittent, it is extremely probable that electrical methods offer the most eocnomical solution of the question, but against this the question of maintenance is often of more importance than the economy of operating expenses due to cheaper power.

Labor.

The class of labor employed in many foundry operations is not possessed of any amount of mechanical skill or electrical knowledge and for this reason it is advisable that the motive power portion of the equipment be as nearly "fool-proof" as possible and of the simplest possible construction in order that it may not be damaged by misdirected zeal. The use of electrical power necessitates the employment of one or more men to look after the motors, depending upon the number used, or else a considerable portion of the minor repairs must be made by outside help. Where the foundry is operated in conjunction with a machine shop the matter of maintenance becomes more simple. With steam, compressed air or hydraulic machinery the question of maintenance is not of such a complicated character as with electrical machinery, owing to the fact that it is much easier to get men who have some primary ideas and break them in to the small repairs required to keep the machines in operating condition. And with the exception of the most extraordinary breakdowns, such machinery can be restored to working order by the use of the facilities ordinarily available in the vicinity of a foundry. This however is not always the case in regard to electrical machinery, though since the uses of electrical machinery are extending so rapidly a time will be reached when the question of repairs will be as simple as it is with other types of motors.

THE ELECTRIC DRIVING OF ROLLING MILLS

By William T. Dean.[1]

This article is a study of the conditions to be met in the application of electricity to rolling mills. It covers the choice of prime mover, whether it be steam engine, gas engine or steam turbine, and discusses the system of transmission to be used. Mr. Dean makes out a strong case for the steam turbine as a generating unit.—Editor.

The recent successful development of internal combustion engines in large sizes suitable for use with blast furnace gas has directed the attention of steel works engineers and managers to the possibility of electrically driving all the machinery in such plants.

So few years have elapsed since the electrical department of most steel plants consisted of a chief electrician and one arc lamp trimmer, that the growth of the electric drive has been almost incredible. Today contracts are being carried out involving the complete electrical operation of mills to produce 100,000 tons of rails per month, where the motor units reach the enormous output of 10,000 horsepower each.

In this country, the Edgar Thomson works of the Carnegie Steel Co. has the honor of using the first heavy rolling mill drive by electric motors. The system used in this mill (250 volts direct current) is probably the most expensive in first cost and least economical in operation that could have been selected, nevertheless, the installation has been a notable success from the beginning. It is quite probable that the transmission line for the light rail mill at the Edgar Thomson works cost as much as the two 1,500-horsepower direct-current motors used, and the building for housing the starting and speed controlling rheostats would accommodate a very fair boiler plant.

The first consideration in any particular case involving electric drive is—will it pay? Can more steel be turned out for a given cost, or the same steel for a lower cost than with a steam driven mill? The next question is—will the electric motor meet the severe requirements of steel mill practice such as continuous operation 24 hours per day and 30 days per month, will it withstand severe overloads even to the point of stalling, will the serious mechanical shocks incident to rolling, destroy bearings and deteriorate insulation to such an extent as to render the maintenance cost of such machines prohibitive? The comparative costs will be taken up later. All the questions that arise affecting the adaptability of the motor for rolling mill operation have been asked and successfully answered in the past as applying to less important machinery. The solution of the problem from the electrical manufacturer's standpoint is only one of degree and therefore rests with the designer. That the many problems entering into the design of the successful mill motor can be solved is evidenced by the mills now being operated electrically and by those undertaken on so great a scale

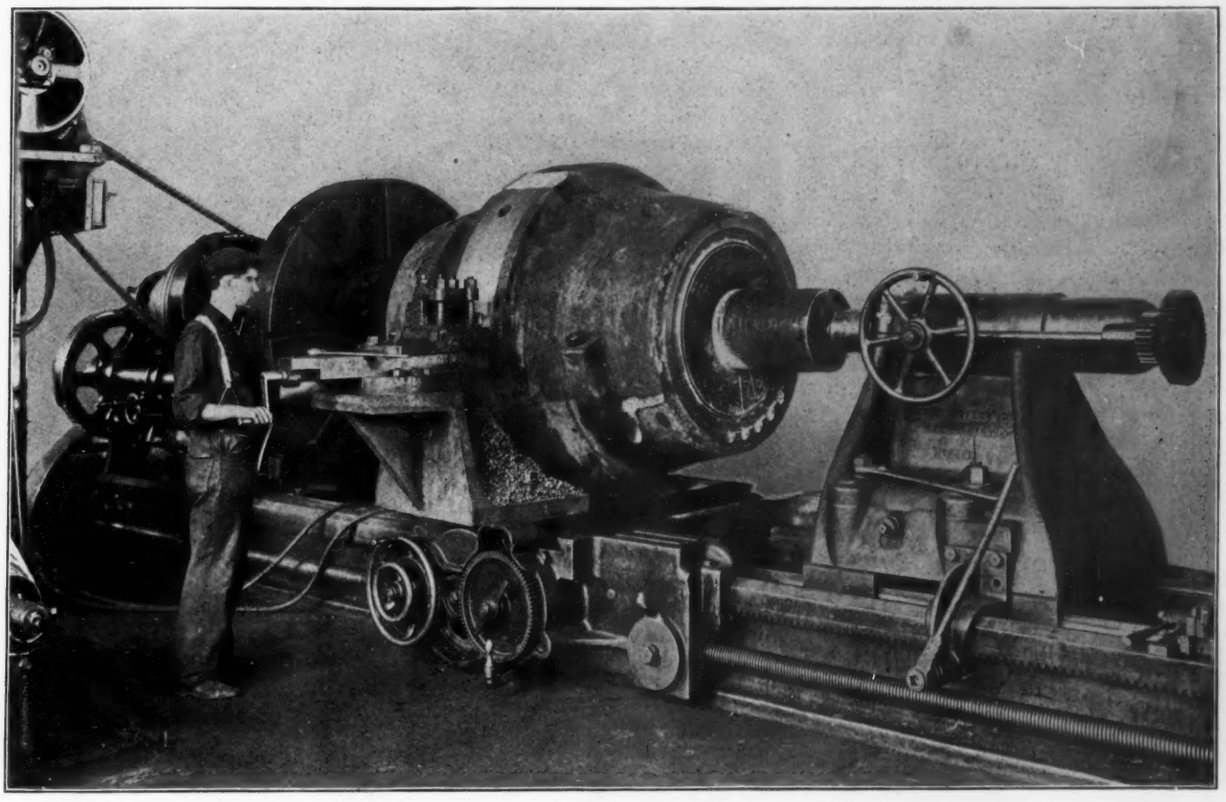


Fig. 1—Ball Bearing of 6,000-Horsepower Induction Motor for Indiana Steel Co. in Process of Construction.

[1]General Electric Co., Monadnock Block, Chicago.

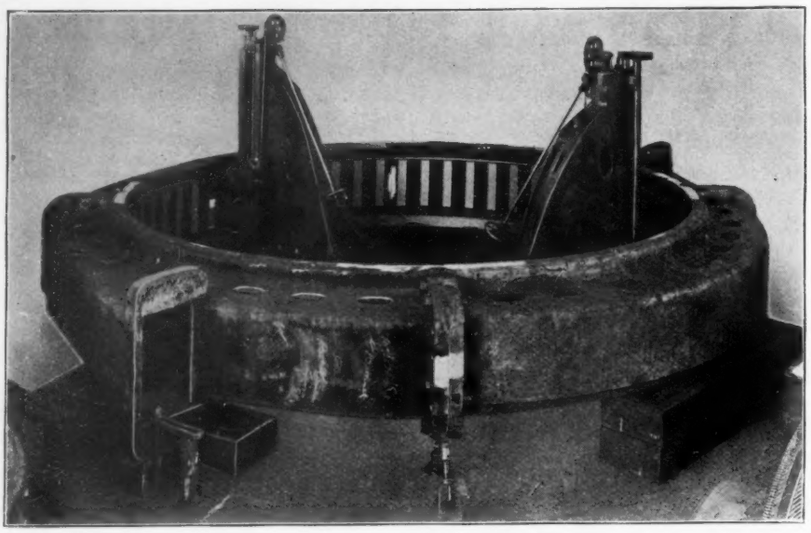


FIG. 2—ARMATURE FOR 6,000-HORSEPOWER INDUCTION MOTOR FOR THE INDIANA STEEL CO. BEING FINISHED IN BORING MILL.

by the United States Steel Corporation.

The ability of a motor to operate continuously at a given load is only limited by its ability to radiate the heat in which the relatively small energy losses appear.

Constants of electrical design, such as safe amperes per square inch in copper conductors, and flux densities in laminated steel, are well known to the electrical designer by years of experience. Generators of as great capacity as the largest motors contemplated, have already been designed, built, and are in successful operation. It may be conceded then with reference to continuous operation, that no serious difficulties will be encountered. The electric motor has a great advantage over the steam engine in the matter of performance under overload. Speaking of the induction motor particularly, it may have an overload capacity as great as 2½ times its continuous output and the motor may be brought to a complete standstill by an unusual overload and the current flowing in the motor windings under these conditions may be precisely calculated before the motor is built, and provision made to limit the maximum current flowing to a predetermined value. What is of equally great importance, however, is the fact that the motor current may be automatically controlled so that excessive strains cannot occur.

The only uncommon problem in the design of large mill motors aside from that of mere size is that of mechanical proportions to withstand shock and ordinary wear. It is in this particular that the electrical manufacturer has been obliged to revolutionize all his previous ideas. How well he has profited by the experience of the engine builder may be gathered from the massive construction shown in the illustrations.

FIG. 3—PEDESTAL OF 6,000-HORSEPOWER INDUCTION MOTOR FOR INDIANA STEEL CO.

Many of the mechanical shocks occurring in rolling operations with steam engines are due to the reciprocating motion of the engine and not to the mill and gears. All such shocks disappear when a motor is used, for one of the motor's most valuable characteristics is its uniform turning moment.

When a mill is driven by a cross-compound or twin-tandem-compound engine the shaft receives its turning moment in four impulses; if the cranks are quartered there are four points in each revolution when only one cylinder, or one engine, if twin engines are used, is effective. Very heavy fly wheels must be provided to overcome this defect, or if the mill is of the two-high reversing type, each cylinder or engine must be made large enough to provide for the maximum torque and there is great probability of entering a slightly cold bloom or ingot at one of the low torque points in the cycle, entailing backing out and loss of time. A motor having uniform turning moment and a maximum torque of 2½ times normal full load torque could experience no such difficulties. Indeed, it would be a very poorly heated bloom that would not pass through the rolls. As a matter of fact, it is necessary to provide automatic torque limiting controllers not to protect the motor but to protect the rolls and gearing between the motor and the steel.

Having outlined the manifest advantages of the motor for mill driving, the cost of operating a steam engine and an electric motor must be compared. Consider a mill requiring an engine or a motor of a given rated brake-horsepower, and assume a non-reversing three-high mill operating practically continuously, conditions most favorable to the steam engine. If steam must be generated on the premises the engine-driven mill will be most economical since the motor must be charged with the cost of transformation from mechanical into electrical energy at the engine and generator, and the cost of transformation from electrical into mechanical energy at the motor as well as the transmission losses. Even the superior economies of large steam turbine generator units will not overcome such double transformation losses. Assume, however, that there is a distant source of power, natural gas, blast furnace gas, coke oven gas, cheap coal or water power, it will be conceded without argument that power may be transmitted more economically electrically than by any other means. It remains to show the relative cost of transmission and the adaptability of the possible sources of power to rolling mill drive.

The internal combustion engine is not adapted to the direct driving of mills on account of its inability to sustain severe overloads and its somewhat instability under widely varying loads. With gas power available the question narrows to the cost of the transmission of gas and the consumption of the same under boilers at the mill, as compared with the utilization of the gas at the source of supply to produce electrical power for transmission to motor driven mills.

In recent blast furnace practice, it has been found that approximately 123,000 cubic feet of gas is produced per 24 hours per ton of pig iron. Two-thirds of this is available for power for the operation of blowing engines and other purposes, the remaining third being used to heat the air blast. A 500-ton furnace will produce therefore 41,000,000 cubic feet of gas per 24 hours. Numerous tests have shown this gas to have a heat of combustion of 100 B. T. U., or more, per cubic foot. Assuming 90 B. T. U. per cubic foot as a conservative figure the total heat available per 24 hours is 3,690,000 B. T. U. The heat equivalent of one horsepower is 2,545 B. T. U. Therefore, the theoretical power available from the gas is 1,450,000 horsepower-hours, or 60,417 horsepower. Assuming the net efficiency of the gas engine at 22.5 per cent which, if in error, is too high, the total available power from a 500-ton furnace is 13,600 horsepower.

On account of the lean quality of blast furnace gas, cylinder dimensions mut be large and this has kept the size of single units down to about 3,000 horsepower and generators rated at 2,000 kilowatts are generally used. Such generators have an efficiency of about 95 per cent, making the total electrical energy available per 500-ton furnace, 9,360 kilowatts. Of this power about 600 kilowatts is required to operate gas washing machinery, to pump jacket water, provide exciting current for alternating current generators and minor purposes, leaving a net available power of 9,000 kilowatts. From the figures above we have:

153,750,000 = total B. T. U. per hour.

2,545 = B. T. U. equivalent to 1 horsepower, theoretical.

$\frac{2,545}{0.746}$ = 3,420 B. T. U. equivalent to 1 kilowatt, theoretical.

$\frac{153,750,000}{3,420}$ = 45,000 kilowatts, theoretical.

$\frac{9,000}{45,000}$ = 0.2.

or the net efficiency of the entire plant will be 20 per cent.

In a large power plant using steam turbine driven generators and every known method of obtaining high efficiency, it has been found that 27,000 B. T. U. in the coal produce one kilowatt at the switchboard. This is under regular commercial conditions and includes all losses such as banking fires, operation of boiler feed pumps, circulating pumps, air pumps, coal and ash handling machinery, etc., and the plant in question is subject to heavy day loads and light night loads. Careful tests at this plant indicate that if the plant could be operated with a constant 24-hour load, such as obtains in steel mill practice, the economy would be 21,000 B. T. U. per kilowatt at the switchboard. In a similar plant, gas fired, but subject to a steady 24-hour load, a still higher economy could no doubt be secured by the use of furnaces, especially designed to burn the gas. Assuming, however, a fuel economy from gas of 21,000 B. T. U. per kilowatt, we have:

$\frac{\text{153,750,000 total B. T. U.}}{\text{21,000 B. T. U. per kilowatt}}$ = 7,325 K. W.

or with the highest type of plant burning the gas to produce steam and using turbo-generators of large size the power available from a 500-ton blast furnace is 7,325 kilowatts.

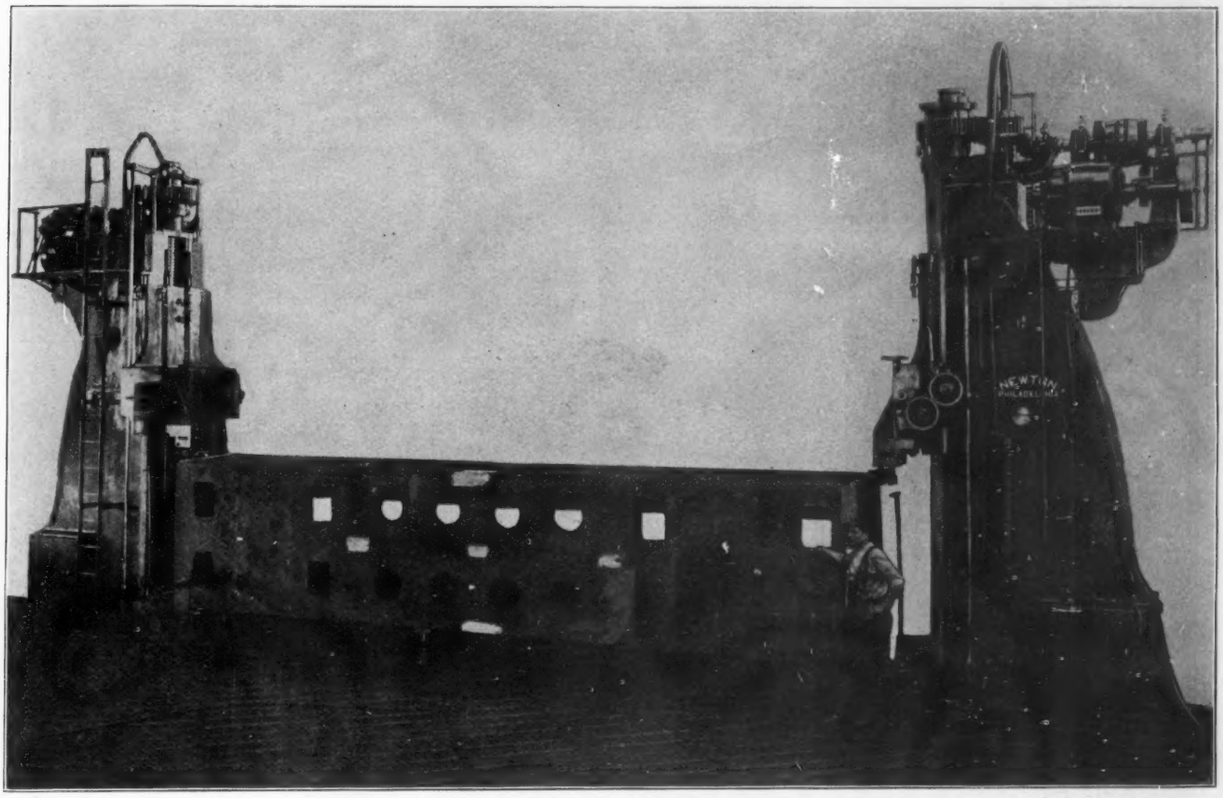


FIG. 4—SECTION OF BASE OF 6,000-HORSEPOWER INDUCTION MOTOR FOR INDIANA STEEL CO. IN PROCESS OF CONSTRUCTION.

As before the theoretical power available is 45,000 kilowatts, giving a net efficiency of 16.3 per cent, or approximately four-fifths the efficiency of the gas engine plant. It should be noted that the higher output of the gas engine plant only applies to cases where blast furnace gas is available, since in producer gas plants the engine must be charged with the heat losses in the gas producer; moreover, the quality of coal for a gas producer must be much higher than is used in the steam plant, on the economy of which the above calculations are based.

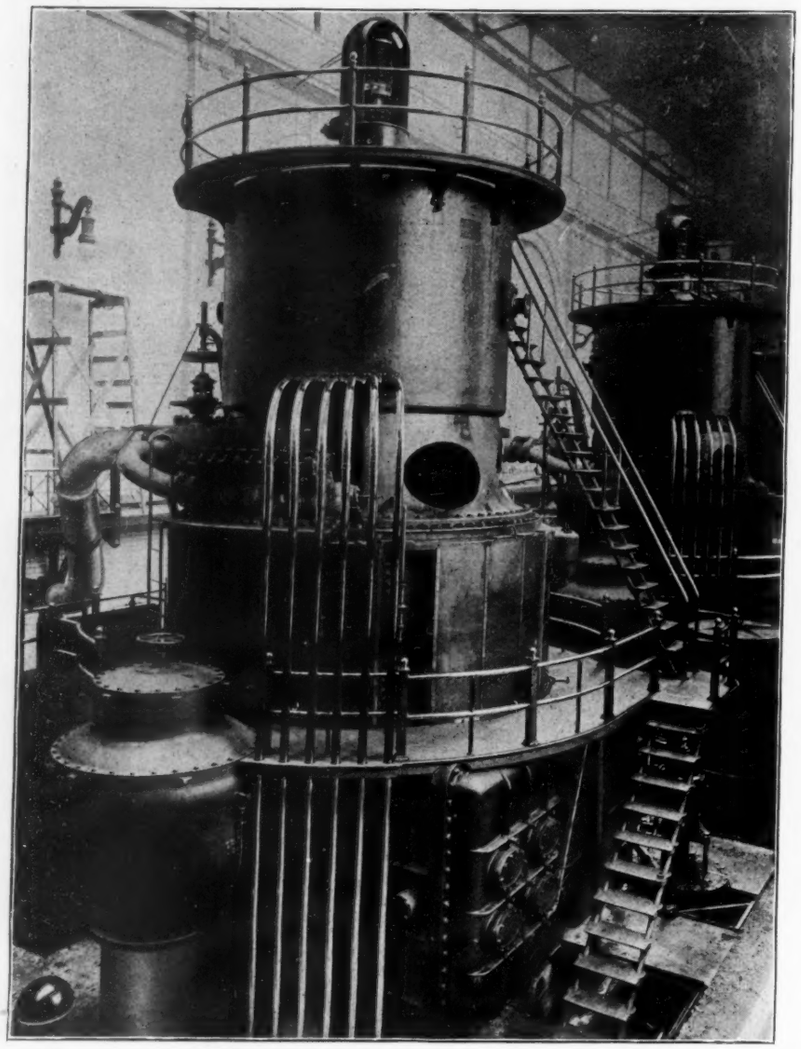


FIG. 5—8,000-KILOWATT CURTIS TURBINE.

The relative reliability of the gas engine and steam turbine plants must be given serious consideration. A steam turbine plant may be operated at its maximum rating indefinitely with almost absolute freedom from shut-downs or necessity of repairs. The gas engine, on the other hand, has not yet reached a perfection of development where it may be depended upon to operate 24 hours consecutively. In one plant of this nature containing four large engines where in emergency one unit could carry the entire load, an entire shut-down occurred, all four of the gas engines requiring simultaneous repairs. The enormous weights of the reciprocating parts, the great cylinder dimensions, the rapid and wide variation in temperatures combine to make the large gas engine somewhat unreliable. That wider experience will teach engine designers methods of increasing reliability cannot be doubted, and the manufacturers of this class of prime movers are to be congratulated that the great steel interests of the country are willing to invest their capital so as to promote so important a development.

Gas engine builders have made many claims as to the reliability of their apparatus, most of which are based on European practice. To those in possession of reliable data on European practice, such claims are taken with a degree of allowance, as the following quotation from *Engineering* (London) testifies:

In this connection we may note that we have recently heard of a large continental power station where it has been deemed advisable to install a reserve plant of 200 per cent of the nominal capacity of the station. As opposed to this, some English builders of turbo-generators are advocating the absolute abolition of all reserve whatever, apart from that provided by the by-pass valve, enabling the unit to take, if necessary, an overload of 50 to 100 per cent.

Certainly the large continental gas-engine may be a success if judged from a non-commercial standpoint. So long as it works, it undoubtedly produces power very economically, but those who have had most experience with them are the very ones who have the longest catalog of their defects.

Early in 1904, contracts were let for gas engines and electric generators of a total capacity of 8,775 kilowatts for Johannesburg, South Africa. It was not until 1906 that power was first delivered and the supply was extremely unreliable.

Quoting from *The Engineer:*

On one occasion when five engines of 7,000 horsepower were running, in the space of a quarter of an hour, every man in the engine room but one was rendered unconscious from gas poisoning. * *

At a coroner's inquest held in May (1907) on a gas fatality, it was stated that 63 cases of poisoning had occurred in six months. * *

At last on May 15 the plant was finally shut down. The engine contractors threw up the contract and admitted that they could not get the plant into shape to pass the specified tests. The town council then rejected the plant. * *

In a report dated March 1 last, the general manager stated that owing to continued break-down the whole of the generator sets had never been available for use at one time. * *

The direct current plant of 5,400 kilowatts had had the greatest difficulty in dealing with the maximum load of 2,750 kilowatts, and it had not been found possible to run the alternating current generators in parallel on account of the unsteady running of one of them. The generator sets could not be got to give more than 80 per cent of their normal full load, and it was seldom that two-thirds of the plant was fit to run. For the three and one-half months ended Feb. 28 (1907) the total works cost had been 5.1 cents per kilowatt-hour as compared with the original estimate of 1.72 cents.

A complete turbine plant of large size, including the best machinery, boilers, auxiliaries, etc., and the highest type of station construction can be built for at least 60 per cent of the cost of a blast furnace gas engine plant of the same capacity with its

auxiliaries. Assuming as arbitrary figures that a steam turbine plant can be built for $60 per kilowatt, and that a gas engine plant can be built for $100 per kilowatt, and that a plant of 40,000 kilowatts average capacity is required, the investment in the turbine plant will be $2,400,000. The gas engine plant, however, will require at least 25 per cent excess in capacity in order to maintain the average output given above and many engineers think that in the present stage of the art, 50 per cent excess capacity should be installed. The investment in the gas engine plant will therefore be $5,000,000, or 108.2 per cent in excess of the investment in the steam turbine plant. The interest on $2,600,000 (the difference in investment) at 5 per cent is $130,000 per year, or sufficient to buy 86,750 tons of coal. If this coal were burned under boilers in addition to the gas obtained from the blast furnaces, it would generate 86,750,000 kilowatt-hours or 1,156 kilowatts 24 hours per day, 26 days per month, throughout the year. This figure makes a very respectable addition to the power given above, which may be legitimately expected to be generated by the steam turbine plant and leaves a relatively small margin of total power in favor of the gas engine plant.

From this showing, the plants depending entirely on gas engines must face very unfavorable conditions. They will have on their hands enormously expensive plants, requiring four or five times as much labor as the equivalent steam turbine plant with constant danger of delay, due to breakdowns and with maintenance expenses reaching large figures.

In addition to all, inherent disadvantages of the gas engine plant previously noted, the fact must not be overlooked that in the space occupied by one 2,000-kilowatt gas engine generator, a steam turbine unit having a rating of 14,000 kilowatts can be installed with all its accessories, and that a gas washing plant used with the gas engines requires more space than a boiler plant for an equivalent turbine installation. In fact, a gas engine plant with its accessories, requires so much space, both in the engine room and out, that considerable difficulty must be experienced to properly operate all sections as a unit plant.

Earlier in this discussion it was proposed to pipe the waste gases to the rolling mills and there generate steam for the operation of mill engines. Neglecting losses in piping which will exceed the losses in electrical transmission, this system would show a lower economy than the turbo-generator system by the amount that the reciprocating engine falls below the turbine in efficiency. Non-reversing mill engines of large size under favorable conditions, operating condensing, require approximately 14 pounds of steam per brake-horsepower-hour. Large size turbines only require about 9.4 pounds of steam per brake-horsepower-hour. The total efficiency of such a system would be

$$\frac{9.4}{14} \times 11.15 = 7.5 \text{ per cent.}$$

For purposes of comparison on the mill basis the efficiency figures on the turbo-generator system and the gas engine plant must be decreased by the losses in the mill motor. Such a motor will have a full load efficiency of about 93 per cent.

The relative efficiency of the three systems of utilizing the waste gases are as follows:

	Per cent Efficiency.
(1) Gas transmitted to mill to produce steam for mill engine	7.5
(2) Gas burned at source producing steam for turbo-generators, energy transmitted electrically to mill motor	15.17
(3) Gas used in internal combustion engines driving generators, energy transmitted electrically to mill motor	18.6

The above figures should not be taken as absolute but give fairly correct relative values, and clearly indicate the wisdom of motor driving rolling mills. The writer believes that the steam turbine system, while not the highest in efficiency, will provide ample power for all rolling mill purposes. If such is the case, the greater reliability of the steam turbine sys-

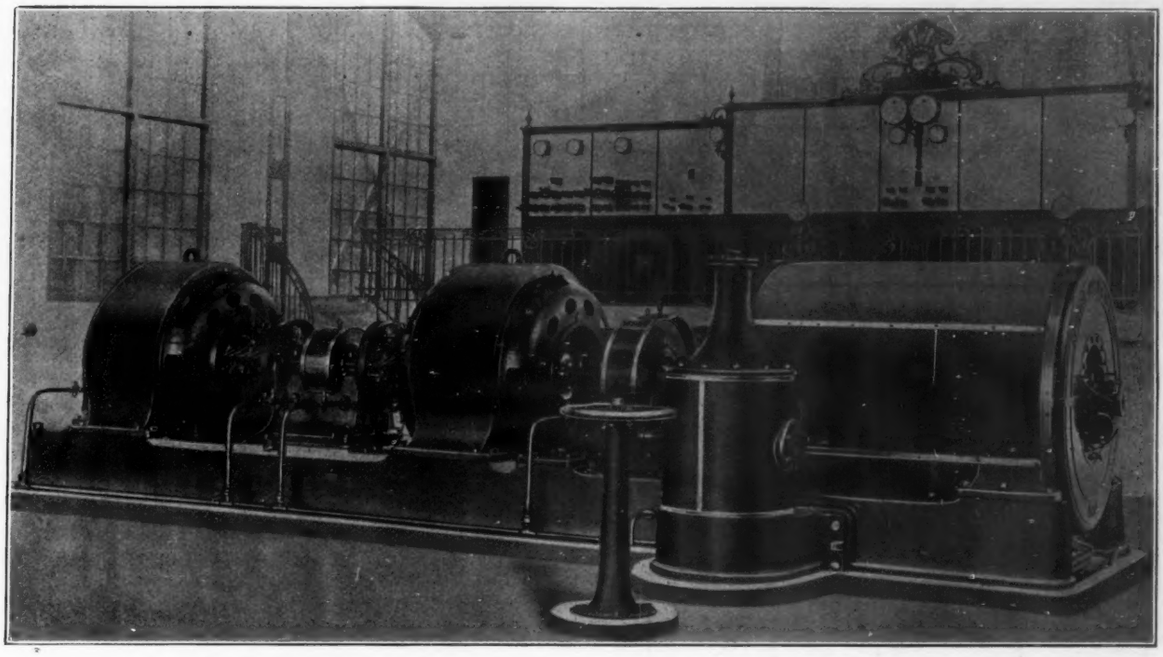


FIG. 6—1,000-KILOWATT RATEAU LOW PRESSURE TURBINE AND DIRECT CURRENT GENERATOR.

tem far outweighs the lower fuel economy, and the extra investment in a gas engine plant will only pay in case there is a profitable market for the excess power outside of the steel mill proper.

There is another source of electrical power for existing steel plants which is extensively used in Europe but has only been utilized in one case in this country and that on a relatively small scale. I refer to the steam regenerator and low pressure turbo-generator receiving an intermittent steam supply from reversing mills or from non-reversing mills subject to wide variations in load or speed or both and delivering a constant supply of electrical energy.

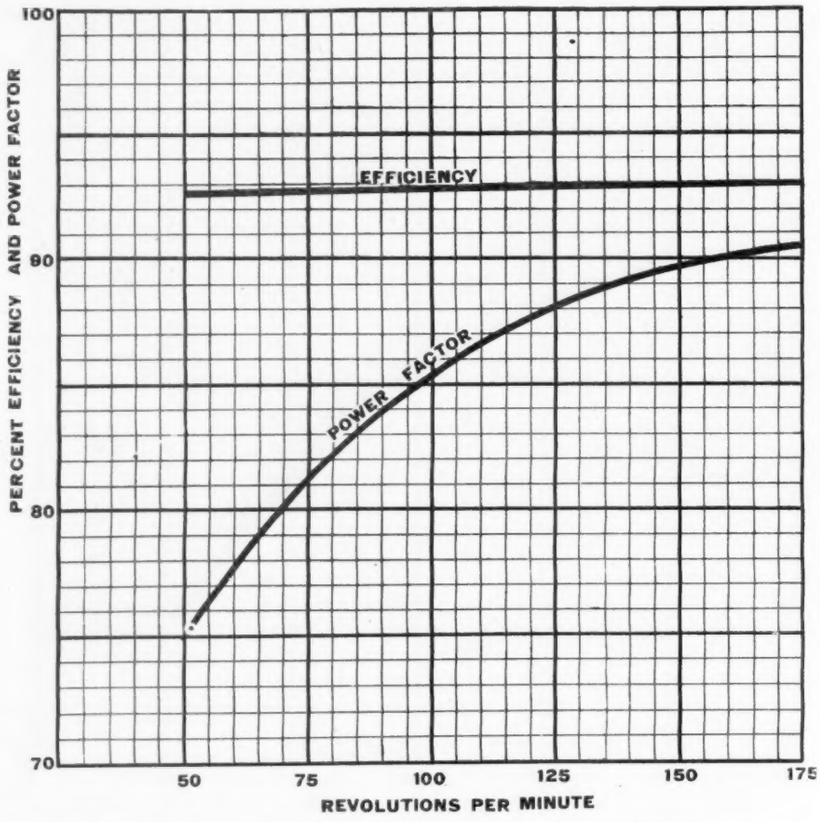


FIG. 7—CURVES SHOWING EFFICIENCY AND POWER FACTOR OF A 5,000-HORSEPOWER MOTOR WHEN DESIGNED FOR VARIOUS SYNCHRONOUS SPEEDS.

A large reversing engine requires 60 pounds of steam (or more) per horsepower. A steam turbine operating between 15 pounds absolute pressure and 28 inches vacuum requires 45 pounds of steam per kilowatt-hour. Thus, there is available 1.33 kilowatts in electrical energy for each horsepower of such engines, more than enough to operate a duplicate mill electrically. The gain by such an installation is all "velvet" and requires a relatively small outlay of capital.

In choosing a system of transmission and utilization of the electric drive the steel works engineer is at first inclined toward direct current, owing to his greater familiarity with that system and to its apparent simplicity. A direct current system has some advantages such as the extension of an existing plant to care for the heavier requirements of rolling mill drive. However, unless the centers of distribution of the power are very close to the generators, the transmission line will be so expensive as to be prohibitive. If an alternating current system is selected the cost of the transmission line may be reduced to a relatively small proportion of the plant equipment.

A universal formula for copper in a transmission line of whatever system, voltage or frequency is the following:

$$A = \frac{D \times W \times C}{P \times E^2}$$

where A = area per conductor in circular mils.
D = distance of transmission (one way) in feet.
W = total watts delivered at end of line.
C = constant depending on the system and power factor if alternating current.
P = percentage of loss in power delivered.
E = voltage at end of transmission line.

The constant C has the following values for the various systems employed:

	Value of "C"				
Per cent power factor	100	95	90	85	80
Direct current ..	2160	....	....	....	....
Alternating current, single phase	2160	2400	2660	3000	3380
Alternating current, two phase	1080	1200	1330	1500	1690
Alternating current, three phase	1080	1200	1330	1500	1690

As an example in point let us consider the relative cost of transmitting 5,000 kilowatts a distance of 2,000 feet by direct current at 220 volts and by alternating current at the same voltage.

From the above formula:

For direct current

$$A = \frac{2{,}000 \times 5{,}000{,}000 \times 2{,}160}{10 \times 220 \times 220} = 44{,}628{,}100$$

Assuming a loss of 10 per cent, two conductors of this cross section each 2,000 feet long will be required, and since the weight of one foot of copper having an area of one circular mill is 0.00000302 pound, the weight per foot of the above conductor would be 134.77 pounds, and the total weight of copper required would be 539,107 pounds or over 269 tons of copper, not including insulation. At 20 cents per pound the copper alone for such a line would cost $107,821.40.

For alternating current,

$$A = \frac{2{,}000 \times 5{,}000{,}000 \times 1{,}690}{10 \times 220 \times 220} = 34{,}917{,}024$$

Assuming the same energy loss as before and a power factor of 80 per cent, three conductors (for three-phase transmission) of this cross section each 2,000 feet long make a total weight of copper of 632,702 pounds, which at 20 cents per pound would cost $126,540.40.

From the above it is evident that at low power factor and equal voltages the alternating current transmission system would be more expensive than the direct current. By reason of commutation and insulation difficulties, direct current voltages cannot be greatly increased; on the other hand there is no reason why alternating current generators and motors cannot be built to operate at 6,600 volts or even higher and by the interposition of transformers the transmission volt-

age may even be raised to 100,000 or 150,000 volts.

Assuming a transmission at 6,600 volts the area of a conductor becomes:

$$A = \frac{2{,}000 \times 5{,}000{,}000 \times 1{,}690}{10 \times 6{,}600 \times 6{,}600} = 38{,}800$$

The current per phase for the above 6,600-volt circuit is 545 amperes. It is not safe to allow less than 1,000 circular mils per ampere, hence 54,500 circular mils or more per conductor must be used. The next larger commercial size of wire is No. 2 B. & S. gage, which has an area of 66,600 circular mils. Substituting this area in the above equation and solving for the value of P we find the power loss to be 5.82 per cent. The three conductors of No. 2 wire would have a weight of 1,205 pounds and would cost $241.80. Thus by using alternating current at 6,600 volts, the cost of copper has been reduced to an insignificant sum and the power loss cut in two. If the power loss were further reduced 50 per cent, the cost of the copper would only be $323.20. It is true that insulators for 6,600 volts cost more than for 220 volts, still in this case the fewer number required and the greatly reduced labor cost overwhelmingly favor the alternating current high voltage system.

The saving is proportional in all cases. During the past summer, the writer had occasion to figure on a system involving three 500-kilowatt generators with a transmission of 2,000 feet. The purchaser was offered three 500-kilowatt, 2,300-volt alternating current generators, three 500-kilowatt rotary converters with all necessary switchboards and the copper for the transmission line for a sum about $45,000 lower than he paid for the 250-volt apparatus and line decided upon. The consulting engineer in charge, while an excellent blast furnace man, knew nothing of electrical matters and allowed his client to pay the extra cost for a plant which must sooner or later be remodeled to an economical basis.

Alternating current motors are now offered, which successfully perform all the functions of direct current motors and have many superiorities, such as absence of commutator and ability to handle extreme overloads. These motors are built in all sizes for the operation of roller tables as well as for the operation of the main rolls, hence, there is no longer an excuse for the direct current system where large powers are used.

The particular voltage to be selected depends on the distance of transmission and the amount of power transmitted as shown by the above examples. Consideration should also be given to the possible expansion of the plant. For a plant generating 10,000 kilowatts or more, 6,600 volts should be the minimum for transmissions of a mile or so. The choice of frequency is limited to 25 or 60 cycles. The lower frequency is preferable, owing to the lower motor speeds obtainable with reasonable cost. The speed of an induction motor is inversely proportional to the number of its poles and directly proportional to the frequency of the source of supply. If the frequency be stated in alternations per minute, the speed will be

$$\frac{1}{N}$$

of the alternations, where N represents the number of poles. Thus, a six-pole 25-cycle (3,000 alternation) motor will have a synchronous speed of 500 revolutions per minute, while a six-pole 60 cycle (7,200 alternation) motor will have a synchronous speed of 1,200 revolutions per minute. The difference in frequency becomes very apparent in large slow speed motors for direct connection to rolling mills.

Synchronous and Full Load Speeds for 25-Cycle Motors.

Poles.	Synchronous Speed.	Full Load Speed.
60	50.00	48.50
58	51.70	50.20
56	53.50	51.80
54	55.50	53.80
52	57.70	55.90
50	60.00	58.20
48	62.50	60.70
46	65.20	63.30
44	68.20	66.10
42	71.40	69.30
40	75.00	72.80
38	78.90	76.50
36	83.30	80.80
34	88.20	85.40
32	93.75	91.00
30	100.00	97.00
28	107.10	103.30
26	115.40	111.40
24	125.00	120.60
22	136.30	131.50
20	150.00	144.80
18	166.60	160.80
16	187.50	181.00
14	214.30	207.00
12	250.00	241.00
10	300.00	290.00
8	375.00	362.00
6	500.00	482.00
4	750.00	720.00
2	1500.00	1440.00

Such a motor operating at 75 revolutions per minute would have 40 poles if 25 cycle, and 96 poles if 60 cycle. A large number of poles makes a difficult design unless very great diameters are used and in any case has a very bad effect on the constants of the machine, particularly the power factor. Unquestionably a frequency of 25 cycles is preferable for power purposes.

The question of suitable speed for a motor driving a rolling mill should be solved by the mill engineer rather than the motor manufacturer. The former should, however, bear in mind the limitations of speed within which the latter must work. Probably the lowest speed for direct connection to rolls which would be considered would be 50 revolutions per minute for 25-cycle motors. The accompanying table gives the synchronous speeds possible and the probable full load speeds for large 25-cycle motors.

Whenever the speed of the rolls exceeds 55 revolutions per minute it is preferable and cheaper to direct-connect the motor than to employ a gear reduction. This refers to mills requiring motors of 3,000 horsepower and larger for a single roll stand, and to many cases where smaller motors would be employed. Where it is necessary to drive more than one roll stand from a single motor, thus entailing gearing which would in any case be charged against the mill, a higher speed motor should be used, but in no case should the gear ratio be greater than 3:1. For motors of 2,500 horsepower or larger, a lower gear ratio should be selected.

For a close group of small mills, each of which in succession does a portion of the total work of reducing a bloom to a commercial shape, the most economical drive is by a single motor. This is due to the higher efficiency of a single motor of large size over several small motors and to the fact that such a motor may be operated at more nearly its full load continuously. The first cost of such a plant will be appreciably lower when a single large motor is installed.

The method of driving a group of small mills from a single motor must be very carefully considered in each case. If bevel gears are used the driving shaft must operate at a relatively low speed in order to avoid the use of too high a gear ratio between the shaft and rolls. This means a low speed and consequently an expensive motor. If the conditions will allow the use of a rope drive the motor may have a fairly high speed and the total friction loss may be reduced. It is probable that the maintenance cost of a rope drive for a group of small mills will be lower than for the equivalent bevel gear drive. Any flexible connection, such as a rope drive between the mills and the motor, will be favorable to the operation of the latter. In general it may be said that the higher the motor speed adopted the better will be the efficiency and pow-

er factor. This is shown by the curves giving approximate value of power factor and efficiency for a 5,000-horsepower motor designed for various synchronous speeds.

Summarizing the various conditions which must be considered in any proposed rolling mill drive, it has been shown that:

1—The electric drive is absolutely reliable.

2—Alternating current motors and transmission system should be used.

3—A frequency of 25 cycles per second is preferable.

4—With blast furnace gas available the greatest amount of power may be obtained from a gas engine plant.

5—A boiler plant with steam turbines will produce four-fifths the power obtainable with the same fuel used in a gas engine plant.

6—The great reliability of a steam turbine plant outweighs the excessive power obtainable from a gas engine plant.

7—The saving in investment in a steam turbine plant over a gas engine plant is very considerable.

8—It is more economical to generate electric power at the source of gas supply and to transmit same to motor driven mills than to burn the gas under boilers at the mill.

9—The electric drive is the most economical system for every case excepting where coal must be burned under boilers at the mill and in this case approximately double the power can be obtained from a given amount of steam by using low pressure turbines in the exhaust from mill engines.

The writer believes the foregoing conclusions to be correct and that a careful investigation on the part of any steel works engineer will prove their correctness.

A NEW BLUE-BLACK IRON PAINT[1]

By F. J. R. Carulla.

In the preparation of iron and steel rods for wire drawing and galvanizing, as also in the preparation of plates for tinning, etc., the iron is kept for a time in a bath of acid to remove the scale. The acid used may be sulphuric acid, when a solution of sulphate of iron ("copperas") is produced; or hydrochloric acid may be employed, when a solution of chloride of iron is obtained.

Methods have been devised to utilize these solutions, but the object of this paper is to describe the one which is the most valuable when chloride liquors have to be dealt with.

The chloride liquors are generally dealt with by adding some base which, combining with the chlorine, will precipitate the iron as an oxide. Lime has been employed; but the calcium chloride produced is a very soluble and deliquescent substance of little use. Certainly the calcium chloride solution might be run away, but it is said to have been successfully employed for watering roads and preventing the dust arising from the passage of motor cars. Potash and soda have also been suggested and employed as bases for the precipitation of the oxide of iron, but the product obtained has obviously a value much below that of the materials employed.

It occurred to Dr. C. F. Wulffing that ammonia might be employed to effect the precipitation in question, seeing that the value of the ammonium chloride is greater than that of the ammonia employed.

The drawback to such a process is that the volatile nature of ammonia necessitates the use of apparatus so closed as to preclude the escape of ammonia, especially as the liquor has to be blown for a long period, in the presence of ammonia, some of which the air would otherwise carry off.

The necessity for this blowing or oxidation arises from the fact that Dr. Wulffing's main object is to obtain a black oxide of iron, which is only produced after long exposure to the air blast. The oxide obtained is a beautiful blue-black color, quite insoluble in water, and when passed into the filter-press leaves a clear solution of ammonium chloride which is evaporated and allowed to crystallize.

The blue-black precipitate is magnetic, showing it to be Fe_3O_4, and is a valuable addition to the list of pigments that can be employed for the protection of structural iron work.

By similarly treating the chloride liquors with other bases a black color can be obtained, but it is not of the extreme fineness possessed by the substance when ammonia is employed. Whatever method may be employed, absolute chemical purity is unattainable. If the process be attempted with lime, some of this most undesirable impurity remains behind, the color produced, moreover, being of a poor quality. With ammonia, on the other hand, the black oxide is left with a trace of a double salt, which Dr. Wulffing regards as NH_4Cl, $FeCl_2$. This acts beneficially on the paint, although ammonium chloride by itself would not do so. Structures that have been painted with this blue-black oxide of iron (boiled linseed oil being used in the preparation of the paint) have kept fresh though exposed to the weather for nearly two years, still showing a varnish-like surface.

[1]From a paper read at the Vienna (Sept., 1907) meeting of the Iron and Steel Institute.

USE OF BORINGS FOR ANNEALING SCALE.

By Dr. Richard Moldenke.

A number of years ago the custom of adding cast or steel borings to the scale used for packing about castings to be annealed came into vogue, and has continued more or less to the present time. The object at the time this was introduced, was first to get rid of a drug on the iron market, and second to take up the burning effects of any stray air that might get into a pot and thus save the sharp edges of the castings.

A correspondent asks about the quantity to be used. First of all it is better to prevent the trouble than to correct it. That is to lute up the pots properly, so that small currents of air cannot enter and circulate about the castings, which should be packed so tightly in scale that no openings are left between them. This will obviate the use of any borings.

However, if it is an economic question, that is if the borings cannot be sold, the supply that comes from the machine shop can be scattered on the scale piles every day in any quantity up to the amount which will not be oxidized in the first anneal. That is, if so large a quantity of the borings is used that when dumping the pots a large amount has remained unoxidized, or only partly so, more has been put in than was necessary to accomplish the object desired. Reduce the amount accordingly.

As a general rule there is seldom more than a fraction of a per cent of the annealing scale used daily, made on borings in the machine shop of a malleable works, and hence the question is not a very live one. If a good price can be obtained for the borings, it is better to sell them than to add to the scale.

ELECTRIC FURNACES FOR THE IRON AND BRASS FOUNDRY

By John B. C. Kershaw.[1]

Mr. Kershaw here presents the cases in which the electric furnace may displace the cupola and melting furnace in the foundry. He shows that, notwithstanding its higher cost of operation, the electric furnace may be a profitable investment in certain cases. The forms of furnace available for this use are described and illustrated.—Editor.

Electricity is undoubtedly an expensive heating agent, and at first sight proposals to employ it for producing molten metal for casting may appear to be not worth the consideration of practical men.

The equation for the heat equivalent of engine power when converted into heat by causing the electric current produced by it to pass through a resistance, is

$$H = 0.393 \times I.H.P. \times E.$$

in which H represents the heat produced per second in pound-centigrade units, I. H. P. represents the indicated horsepower of the engine, and E represents the combined efficiency of engine and dynamo.

Taking now a generating plant of the most modern type with a combined efficiency of engines and dynamos of 85 per cent, and using 3.5 pounds of coal per kilowatt-hour generated (equivalent to 2.6 pounds per electrical horsepower-hour) we have the following comparison: Heat produced by burning 2.6 pounds of coal, testing 7,900 centigrade units per pounds = 20,540 units.

Heat produced by one horsepower-hour after conversion into electric energy, and use of this energy to produce heat by resistance heating:

$$0.393 \times 1 \times 0.85 \times 3{,}600 = 1{,}201 \text{ pound-centigrade units per pount.}$$

The ratio between the heat available in the coal burned, and that produced by the electric current when employed for resistance heating, is thus $\frac{20{,}540}{1201.0}$, or $\frac{17}{1}$, and as already stated when studied in this manner, the proposal to employ electric methods of heating in the iron and brass foundry seems to offer no practical advantage. Even should the electric energy be generated by water power, the economic advantage would seem to be on the side of the use of coke for heating purposes, say at $4.25 per ton, unless the electrical horsepower-hour could be sold to the consumer at the rate of 0.0296 cent, or $2.58 per electrical horsepower-year. This figure is about one-half the lowest rate yet quoted for electric energy, even in Norway and Switzerland. Unless, therefore, some very important and valuable advantages result from the use of electricity as a heating agent, its application in the iron and brass foundry is an innovation which must be long postponed. It is the purpose of the writer in this article the point out what these advantages are, and to describe some of the forms of furnace which might be employed for this special purpose.

[1]West Lancashire Laboratory, Waterloo, Liverpool, Eng.

Advantages Offered by Electric Methods of Heating.

The first and most important of these advantages is that the heat can be generated where it is required, that is *within the mass of metal* requiring to be melted, and that the efficiency of the resistance type of furnace may by careful work be raised to over 75 per cent. The losses from radiation and conduction are in fact greatly reduced as compared with the usual methods of work. How large the heat losses are in metallurgical operations as ordinarily carried on can be gaged from the following tabular statement prepared by Prof. Burgess, of the University of Wisconsin.

Product.	Type of Furnace.	Thermal Efficiency Per cent.
Cast iron	Blast	52.6
Steel	Acid process	11.9
Steel	Basic process	10.0
Pig iron	Reverberatory	8.5
Wrought iron	Reverberatory	5.0
Steel	Siemens crucible	4.0
Steel	Greenwood crucible	2.0

The blast furnace stands in a category by itself, and it will be many years before it is displaced. The values for the efficiency of the furnaces used for producing steel and wrought iron were calculated by comparing the heat theoretically required to raise the metal to the molten state, with that present in the fuel actually required to produce the effect in practice.

If these efficiencies be accepted as correct, the superior economy of direct heating by fuel largely disappears, for when 9/10 or 19/20 of the heat value of the fuel is lost, and only 1/10 to 1/20 is successfully utilized, the two methods of heating are practically on a level.

A second advantage offered by electric heating is that the furnaces and crucibles would have longer life than by the usual methods of work, since they would not be exposed to any external heating, and the highest temperature would be attained within

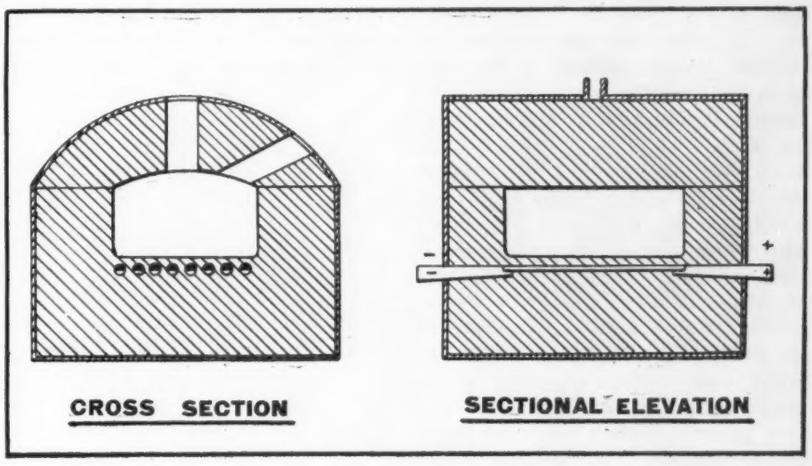


Fig. 1—Faure Electric Furnace

the mass of metal they contained, rather than at the exterior of the furnace or crucible walls. Another advantage no less important is, that the metal during the melting operation need not be exposed to the air or to the products of combustion of the fuel used, and that therefore

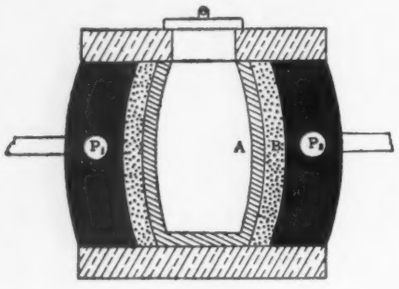


FIG. 2—THE GIROD FURNACE

some of the losses due to the formation of oxides and dross would be avoided. In the melting of the finer kinds of steel, the possibility of conducting the melting operation under the surface of a protective flux or in an inert atmosphere, is of considerable value. The final advantage which will be named here, is the cleanliness with which the melting of the metal naces or crucibles, a certain amount of the ash of the fuel which is always present as dust in the atmosphere of the building, must get into the molten metal, and the silica, which is the main constituent of this ash, may have prejudicial effect upon the physical properties of the finished metal. With the better forms of electric heating, this contamination of the product is impossible, and the chemcal constitution of the finished metal can therefore be more accurately gaged and controlled.

Description of Electric Furnaces Suitable for Melting Iron and Brass.

Electric furnaces are either of the arc or resistance type, and in this article only furnaces of the latter class will be described since arc furnaces are not suited for the work required.

Electricity can be employed for resistance heating in several ways. In furnaces of the first type, the crucible is imbedded in infusible resistance material such as granular carbon, carborundum or "kryptol," and the heat effect is produced by heat transmission through the furnace walls. This type of furnace sacrifices some of the high efficiency expected with the adoption of electric heating, since the heating is external and the losses from radiation may be fairly high. In furnaces of the second type, the metal to be melted is used itself as the resistance, that is the heat is generated internally, and the full advantage of electric heating is obtained. The current of electricity in this type of furnace is either passed directly through the metal, by aid of a suitable conducting medium—or the heat effect is produced by induced currents using the metal to be melted as the secondary circuit of a furnace erected on the transformer plan. In all cases alternating current is used, since this is more easily controlled than direct current, and the dangers of electrolytic action are obviated.

The temperatures required will range from 900 degrees Cent. equivalent to 1,652 degrees Fahr. for melting brass up to 1,375 degrees Cent., equivalent to 2,507 degrees Fahr., the temperature at which steel melts. The actual current strength required with the particular furnace employed, can only be ascertained by actual experiment. The electro-motive force of course varies with the thickness of resistance between the two current terminals, and it will generally be found best to work with a current supply of low pressure, say 50 to 100 volts. The following figures from an article by Vogel upon electric resistance furnaces using solid carbon electrodes as resistance material, will however serve as a rough guide to the current strength demanded:

Amperes per square millimeter of cross section of carbon resistance.	Corresponding temperature—Degrees Centigrade.
0.25	590
0.33	710
0.45	990*
0.54	1110
0.66	1210†
1.20	1600
1.60	1850
2.00	2300

*Brass melted.
†Cast iron melted.

The limits of temperatures between which the furnaces for brass and steel melting would operate, are therefore represented by current densities of from 0.45 to 1.20 amperes per square millimeter of cross section of the resistance material, when this is solid carbon. With the other material, granulated carbon, graphite and carborundum, the current densities will be somewhat lower, since their electrical conductivity in the granulated state will be less than that of solid carbon electrodes.

One of the earliest electric resist-

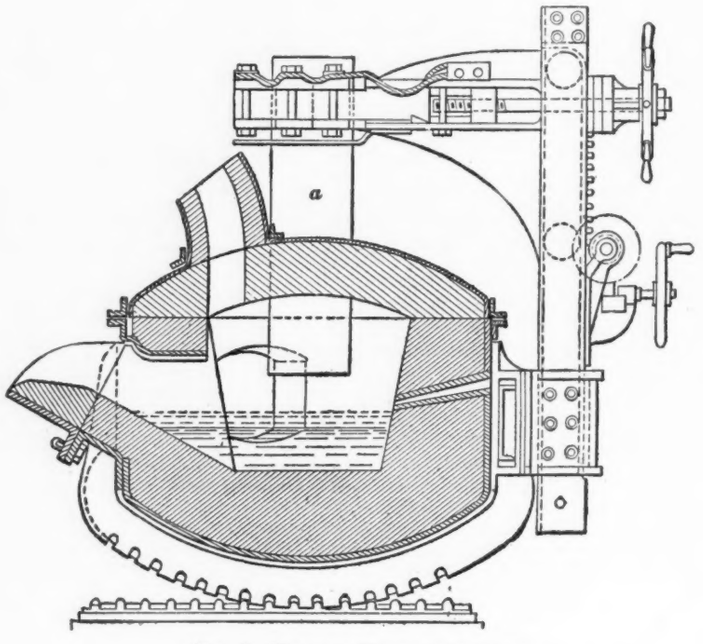


FIG. 3—HEROULT ELECTRIC FURNACE

ance furnaces designed was patented by Faure in 1883. Fig. 1 shows the construction of this furnace, which was built of firebrick on the usual lines of a reverberatory furnace, but in the bed of the furnace eight channels were filled with resistance material. These "resistors" were connected as shown in the sectional elevation to the current mains supplying an electric current of low potential but large ampereage. The heat produced in the bed of the furnace by the electric current passing through the resistance was thus communicated to the charge lying above it, and by

varying the current intensity different temperatures could be attained. Although this furnace has not to the writer's knowledge been employed in electro-metallurgy, its simplicity and adaptability to many purposes are points in its favor. Good heat insulation of the bed would be necessary however, to prevent large losses by radiation.

A crucible form of furnace invented by Girod, heated by an external resistance H in which the crucible is embedded, is shown in sectional elevation in Fig. 2.

The crucible, A, is made of some highly refractory material and is surrounded by silicon and graphite, B, in granular form. Carbon blocks P_1 P_2 P_3 P_4, are placed at equal distances around this ring of resistance material, and are separated by insulating blocks to prevent short circuits. The furnace is mounted on trunnions for facilitating discharge, and in order to prevent unequal heating of the crucible, due to the current selecting the shortest path from one electrode to the other, Girod has taken out an additional patent, covering the use of ferro-silicon as resistance material in this type of crucible furnaces. By making use of different grades of this alloy, different degrees of resistance can be obtained, and in this way the heating effect can be equalized.

This form of crucible furnace is in use for the production of ferro-alloys not requiring a temperature above 1,500 degrees centigrade at three works owned by the Societe Anonyme Electro-Metallurgique Procedes Paul Girod.

Graphite, silicon and carborundum are empoyed as resistance materials with the Girod crucible furnace. Furnaces of this type utilizing each 200 horsepower and producing 2,200 to 4,400 pounds of ferro-alloys per day have been successfully operated since 1903 in the three works at Ugine, Courtpin and Montbovon; and there is no doubt that these furnaces could be employed with success for melting steel or brass.

A detailed description of the erection of a small laboratory crucible furnace of the same type, using granular graphitized coke as resistance material, is given by Fitzgerald in the paper named below[2]. Readers anxious to experiment with electric heating in the foundry, are advised to consult this article, since details are given in it which cannot be reproduced here, on account of the limits of available space.

The crucible form of furnace heated by an external resistance material, can be adapted for either tapping or pouring the molten metal, and can therefore be modified to suit foundry requirements.

Internal Resistance Furnaces.

Turning now to electrical resistance furnaces of the second and more economical type, in which the heat is generated internally by the resistance of the metal itself, four furnaces demand notice, namely those of Heroult, Keller, Kjellin and Colby.

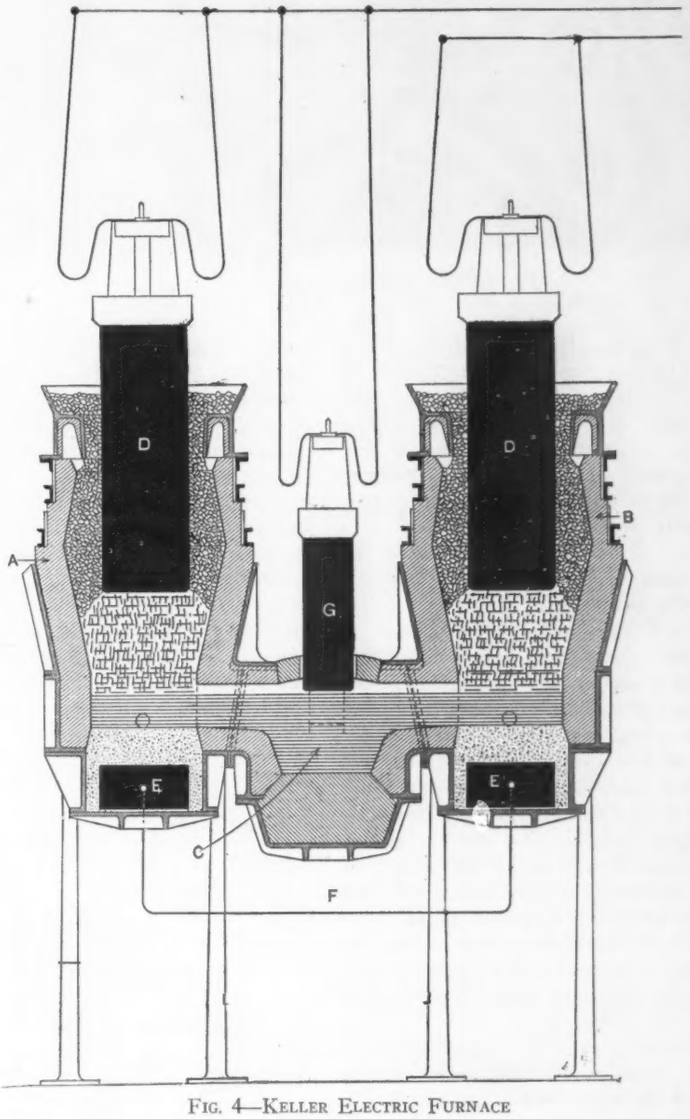


FIG. 4—KELLER ELECTRIC FURNACE

In the Heroult furnace, shown in sectional elevation in Fig. 3, two massive carbon electrodes are employed to conduct the current into and away from the charge of molten metal contained within the furnace. These electrodes just touch the surface of the flux covering the metal, and the heat effect is produced by the resistance of the flux and metal lying between them. A full description of this furnace appeared in THE IRON TRADE REVIEW, July 26, 1906. It is only necessary to add here, that in order to adapt this furnace for melting operations and temperatures below 1,500 degrees Cent., it is necessary to exclude the preliminary arc heating. This is effected by always leaving a third or more of the molten contents, in the furnace after pouring. The carbons can then be kept in contact with the flux lying above this residual metal, and the resistance heating can be continued whilst fresh raw materials are charged. The possibility of increasing the carbon contents of the finished metal is, however, always pres-

[2]Electro-Chemical and Metallurgical Industry.

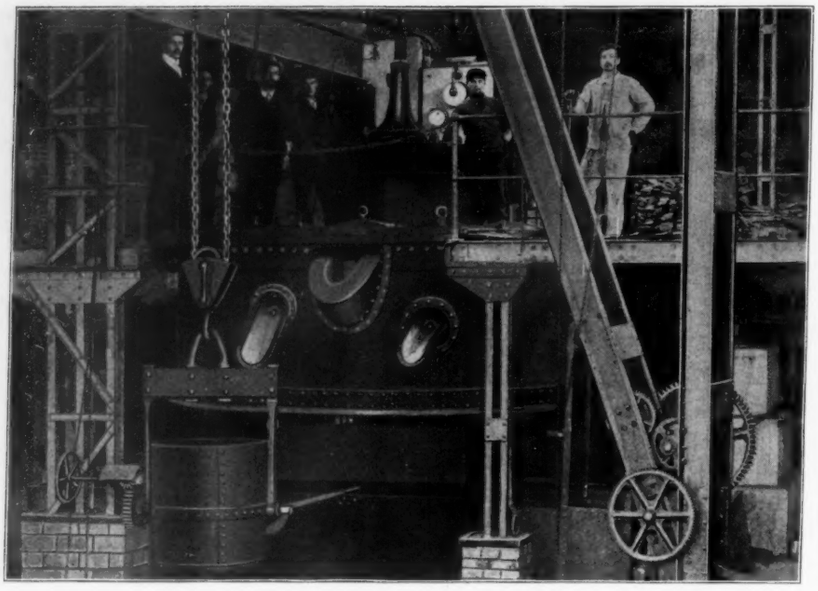


FIG. 5—THE KJELLIN FURNACE AT GYSINGE.

ent with the Heroult furnace when used in this way, and therefore it is not adapted for melting the finer varieties of iron and steel. The choice of a suitable protective flux which shall act as a heating medium, and yet be without action on the constituents of the molten metal, is also another difficulty connected with the operation of the Heroult furnace for foundry purposes.

The Keller resistance furnace is shown in sectional elevation in Fig. 4. In principle it is the same as the Heroult furnace, but the constructional details differ. The massive carbon electrodes are separated and each is enclosed in a vertical shaft, these shafts being connected below by a lateral canal. The current passes from one electrode to the other, by the materials present in these two shafts and in the lateral canal. The details of the construction and of the operation of the Keller furnace, were given in THE IRON TARDE REVIEW, Aug. 30, 1906.

The modifications required to adapt it for foundry work are those already named in discussing the Heroult furnace, namely the prevention of arc-heating by only partial discharge of its contents, and the provision of a suitable flux or slag, to protect the molten metal from contact with the electrode carbons, or with the atmosphere. This furnace is designed for discharge by tapping.

The last types of resistance furnace which will be referred to in this article, are the induction furnaces of Kjellin and Colby. Fig. 6 is a sectional elevation of the Kjellin furnace, and shows it to be in effect a large transformer, in which an alternating current of low amperage but high voltage in the primary coil A, is transformed into an alternating current of large amperage but low voltage in the secondary coil of the apparatus, which in this case is the molten metal and flux contained in the annular ring BB. Further details of this furnace will be found in THE IRON TRADE REVIEW, Sept. 27, 1906. The Colby furnace is similar in design, the chief difference being that the primary coil is made of copper tube, and is kept cool by water flowing through it during the operation of the furnace. Fig. 7 is a photograph of the small 15-kilowatt experimental Kjellin furnace built at Messrs. Vicars' steel works in Sheffield, England, while Fig. 5 is a photograph of the 300-kilowatt furnace in operation at the Gysinge Works in Sweden. It will be observed that both these furnaces are mounted on trunnions and that they can be tilted for discharge.

The smaller furnace will melt 30 pounds of metal in from 20 to 30 minutes, and has a power factor of 57 to 60 per cent.

The larger furnace produces 9,000 pounds of steel ingots per 24 hours in fine castings, 1,760 to 2,200 pounds of metal being poured at each stoppage. The power consumption is 866 kilowatt-hours per ton of 2,000 pounds.

The corresponding figures for the 40-kilowatt Colby furnace erected at the Tacony works of Messrs. H. Disston & Sons near Phiadelphia, are: 550 kilowatt-hours to 750 kilowatt-hours per ton of 2,000 pounds, ingots of 90 pounds being poured hourly, and 100 pounds of molten metal being left in the furnace as basis of the next charge.

In this furnace the fusion of the metal is effected in 30 minutes, and a further 30 minutes heating is required to complete the refining process.

Conclusions.

The above figures give some indi-

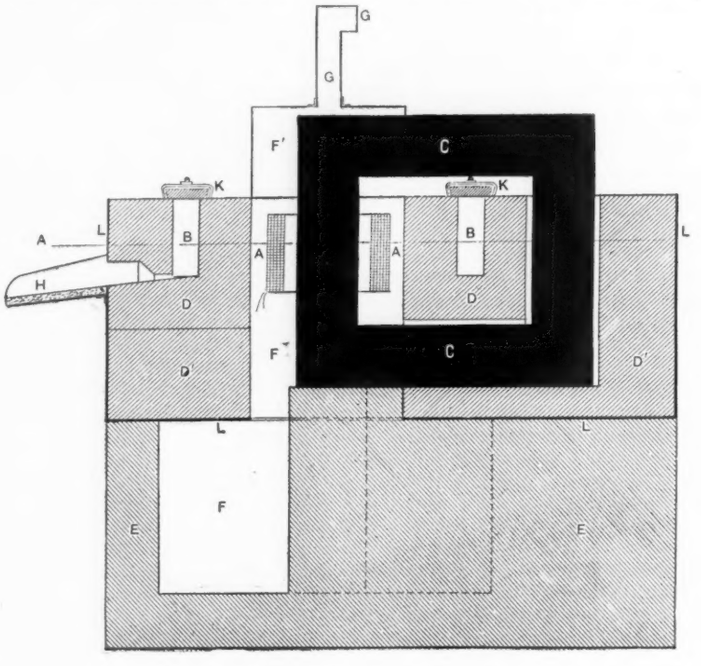


FIG. 6—KJELLIN ELECTRIC FURNACE.

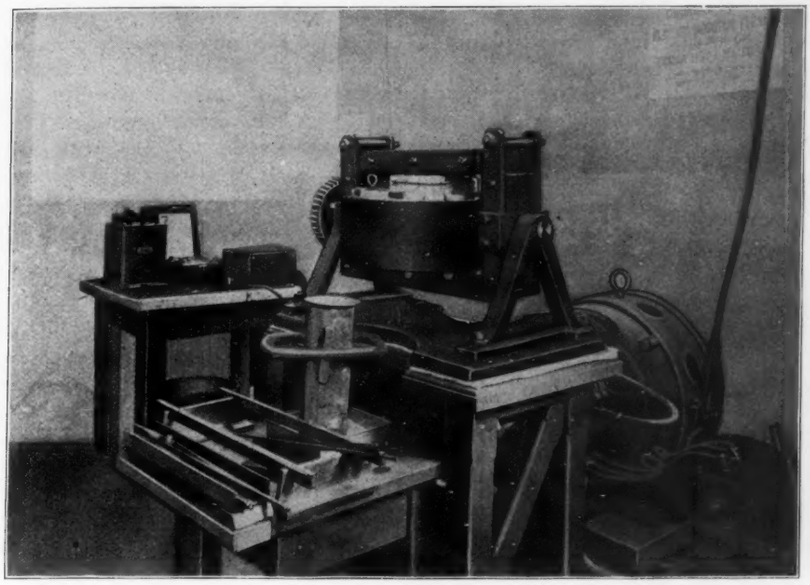


FIG. 7—15-KILOWATT KJELLIN FURNACE AT SHEFFIELD.

cation of the power that would be required in the practical operation of these furnaces for melting steel or brass, since about one-half the electric power is employed to effect the refining process. As a general rule one may estimate that from 400 to 500 kilowatt-hours would suffice to melt one ton of metal in these resistance furnaces with internal heating, and that with cheap electric power (say at $10 per electrical horsepower-year) the cost would not exceed 80 cents per ton. The writer does not suggest however, that a large furnace for electric heating of the metal required daily in any brass or iron foundry should be erected, without preliminary trials in the laboratory or upon a small industrial scale. Each case will demand special consideration by an expert electro-metallurgist with no private axe to grind, and it is quite certain that there will be many cases in which no change can be recommended, as there would be nothing gained by substitution of electric for the ordinary methods of heating.

But in particular cases and industries, especially those relating to the production of fine castings in iron, steel or brass, electro-thermal methods have much in their favor, while the facts and figures given in preceding sections of this article prove that the electric method of working may compare favorably as regards cost, with the older process.

DEVELOPMENT OF THE STEEL CASTING INDUSTRY

BY W. M. CARR.

There is a special significance in the fact that the production of steel castings, more than any other branch of the foundry industry, is subject to rigid specifications and tests. This fact indicates that during the early days of their manufacture, consumers experienced some disappointments in the quality and properties of castings produced by the pioneers of the industry, and sections untrue to pattern, rough and cracked, were responsible for many rejections. Such difficulties are frequently experienced at present, but with due credit to steel foundry methods their occurrences are less frequent than at any time in the past and progressive founders are continually striving to keep their rejections and replacements at the minimum. At one period a loss of 75 per cent in a day's run was not uncommon, but today a loss in defective castings is considered heavy if it exceeds 5 per cent.

Retrospective.

Looking back over the earlier attempts to manufacture steel castings, a rough, unsightly mass of steel presents itself to view, not clearly defined in shape, containing more blow holes than metal and comparing this with a casting produced by modern methods, one is impressed with the smoothness of the surface and the greater certainty of solidity, giving evidence that great advances in methods of manufacture have been made.

The defects of steel castings can be roughly divided into three classes:

(1) Roughness and lack of conformity to pattern as a result of sand burning onto the face necessitating heavy cuts to remove and reach a finished surface.

(2) The frequent liability to crack in the mold while cooling.

(3) Blow holes, cavities.

Such defects were frequent in the earlier attempts at steel casting manufacturing and to trace the development of the industry it will be necessary to refer to records of a comparatively recent date.

The distinction of making the first steel casting belongs to the city of Philadelphia where in 1867 one was made from crucible steel, forming, it is believed, some part of a switch or frog. The mold was made from a mixture of ground fire brick, old graphite pots and fire clay. The surface was washed with plumbago and the complete mold was dried. It is said that the casting was fairly smooth but when machined was found to be more or less honeycombed. This was before ferro-silicon and manganese had come into use as solidifying agents. Subsequent castings made under similar conditions were more or less rough as a result of the molding material persistently adhering to the surface; they were also found to be defective through "hot-cracks," and blow holes were still present. Improvements in appearance were accomplished by substituting sand for the mixture for molding given above. The sand however, lacked bond, and to provide this, flour was used, but in drying the mold the flour would burn out and the mold would collapse. Later, molasses was tried as a bond with greater success in the smoothness of the castings and at the same time "hot cracks" were less frequent because the sand mold had less resistance than the mixture of ground fire brick, etc., and the castings were not held rigidly while contracting and cooling. Blow holes caused considerable difficulty until 1873 when ferro-silicon was suggested as a solidifier.

Introduction of the Open-Hearth Process.

The acid open-hearth process was first introduced in the United States

at Trenton, N. J., in 1867, but this venture was not successful. In 1869 a five-ton furnace was built at South Boston, Mass., and was operated successfully for more than a year producing ingots of good quality. Two years later another five-ton furnace was built at Nashua, N. H., and in the same year a five-ton furnace was built at Pittsburg. The product of such furnaces was mainly ingots and records are obscure showing when the first casting was made from open-hearth steel.

The Bessemer process was introduced in 1867 and was limited almost entirely to the production of ingots with an occasional casting. Converter methods were first introduced for the manufacture of steel castings by the Clapp-Griffith process in 1884.

In 1887 the open-hearth process had reached some prominence in the production of ingots and steel castings, and from that time until the present day open-hearth melting has in tonnage far outclassed all other methods of producing castings.

From the first introduction of castings, and until 1886, steel for any purpose was made in acid lined vessels. In that year basic linings were first used in open-hearth furnaces at Cleveland, and at the Homestead Steel Works, Pittsburg, in 1888.

Statistics prior to the census of 1900 combine the tonnages of ingots and castings and therefore it is difficult to state when the first casting was made by basic open-hearth methods.

In the St. Louis District.

Steel castings were made in the St. Louis district from basic metal in the '90's and credit is due that section of the country for giving prominence to this practice. In 1900 there were produced in the United States, distributed among 11 states, 165,529 tons of steel castings. Of this total 36,524 tons were basic, Missouri (the St. Louis district) being credited with producing 33,000 tons of that output, the balance having been made in Pennsylvania and other states. Of the total production for that year 129,005 tons were acid castings, made largely in Pennsylvania. The basic process for that period only represented 22 per cent of the total output. For comparison, and as an evidence of the tendency of steel casting practice the latest statistics show that basic melting now yields 42.9 per cent of the total production of steel-casting, a gain of 22.9 per cent in six years.

Reviewing such records, one conclusion is plain. Basic melting has won recognition if for no other reason than that it has advanced at a faster rate than acid practice. Furthermore, owing to the growing scarcity of acid melting stock, the time may come when basic melting will lead acid in tonnage. It is also certain that quality has had something to do with the growth of basic practice, otherwise it would not have reached the extended application to meet existing demands.

Reasons For Recent Advances.

The quality of a modern steel casting owes its place in the foundry industry to the following reasons:

(1) Improvements in molding mixtures through the use of refractory silica sand bonded with fire clay either as a mechanical mixture or as a natural one. This step is an advance over the earlier use of ground fire brick and old graphite pots and has resulted in smoother, cleaner castings. Through the same steps "hot cracks" are less frequent.

(2) Melting methods followed in furnaces designed on modern lines to reach a high efficiency from richer fuels—knowing the necessary melting mixtures, melting manipulations and the use of alloys as solidifying agents —have certainly given a greater assurance to the quality of the product in regard to composition and solidity, that on the whole the character of modern steel castings meets with greater ease, specifications and tests, than at any time in the history of the industry.

(3) The application of chemistry and metallurgy. In no branch of the foundry trade is it so important to have full chemical examinations of raw materials before and during the course of conversion and to supplement them in the finished product with physical tests. Without the aid of science a steel foundry is as a ship without a compass.

(4) The cheapening of the product by increasing the size of the furnaces from the smaller capacities to those of 20 to 25 tons.

Future of the Industry.

Upon railroad and marine engineers rests the future of the industry as they have been responsible for the rapid adoption of steel castings in preference to forgings for heavy and important parts. Car construction has been cheapened and simplified through the use of these sections. It is easier to cast in one piece certain parts instead of building up and bolting together forgings or rolled parts. Locomotive frames are easier to cast in one piece than to weld them together from several parts. It is doubtful whether the mammoth locomotives now so generally used would have ever been built without cast steel frames. The same reasons apply to anchors, propellers, propeller struts, rudder frames, stems, stern posts, etc.

In the general machinery trade, steel castings are replacing forgings and gray iron castings to a rapid extent. The list might be extended indefinitely, but it is sufficient to state that modern methods of producing steel castings, while enjoying a worthy position in the arts, have not reached a point where they cannot be placed advantageously in certain directions. They will continue to grow in usefulness, and in electrical engineering, automobile, freight, passenger and street car construction, locomotive, ship building, etc., the limit has not yet been reached.

EFFICIENCY OF CRUCIBLE FURNACES.

The efficiency of crucible furnaces is always very low. In round numbers about 100 pounds of coke will be required to melt 100 pounds of brass. The amount of heat theoretically required can be calculated. Assume that it is copper which is to be melted for convenience (melting point 1,085 degrees Cent.). The specific heat of copper is, according to Frazer and Richards, $0.0939 + 0.00001778t$, so that the heat required to raise one pound of copper from 0 degree to its melting point, 1,085 degrees Cent., will be $1,035 \times [0.0939 + (0.00001778 \times 1,085)] = 122$ units approximately. Taking the latent heat of fusion to be 45, the heat required to raise one pound of copper to its melting point and to melt it would be about 167 units, or for 100 pounds, 16,700. As coke may be taken as having a calorific power of, say, 6,400, 2.6 pounds of coke would be sufficient to melt 100 pounds of copper. Taking the amount given above the efficiency of the furnace will be 0.6 per cent.

It is easy to see the sources of the loss: (1) The coke is not completely burnt to carbon-dioxide, but a considerable portion escapes as carbon-monoxide; (2) the products of combustion must leave the furnace at a high temperature in order to produce a draft. These sources of loss cannot be avoided, but owing to faulty furnace construction, the actual loss is often much higher than it need be.—*The Mechanical Engineer.*

STEEL CASTINGS BY THE McHAFFIE PROCESS

Methods Pursued in the New Plant of the Keystone Steel Castings Co., Chester, Pa.

With six large steel casting plants having a tremendous combined annual output located within its confines, the city of Chester, Pa., has for many years maintained its lead over other sections of the east in the steel casting industry. Early in August this year another steel foundry was placed in operation in this important center, which, unlike its neighbors, employs the crucible and McHaffie steel processes exclusively. The Keystone Steel Casting Co., incorporated on April 11, 1907, was conceived and organized by men of wide practical experience who had served as heads of departments in other steel casting works, and their combined knowledge was utilized in planning and equipping this plant.

The foundry has been built on a tract of six acres on the main line of the Philadelphia, Baltimore & Washington railroad near Lamokin station and the buildings have been so arranged that the plant may be developed to meet the requirements of increased demands without destroying the present layout.

The building which contains the McHaffie department is 160 x 50 feet, one end of which opens into and is used as a part of the crucible foundry. All of the buildings have been substantially constructed, special care having been taken to insure ample lighting and ventilating facilities.

McHaffie Process.

With the exception of the mixture and the subsequent annealing, the McHaffie process is similar to ordinary gray iron practice. The iron is melted in the cupola and is poured into green or dry sand molds. The castings, however, are subsequently annealed, which converts them into a semi-steel. The success of this process depends largely on the careful selection, proper mixing and melting of special grades of imported white and mottled pig iron. A view of the McHaffie foundry, including the cupola lined up to 54 inches inside, is shown in Fig. 1.

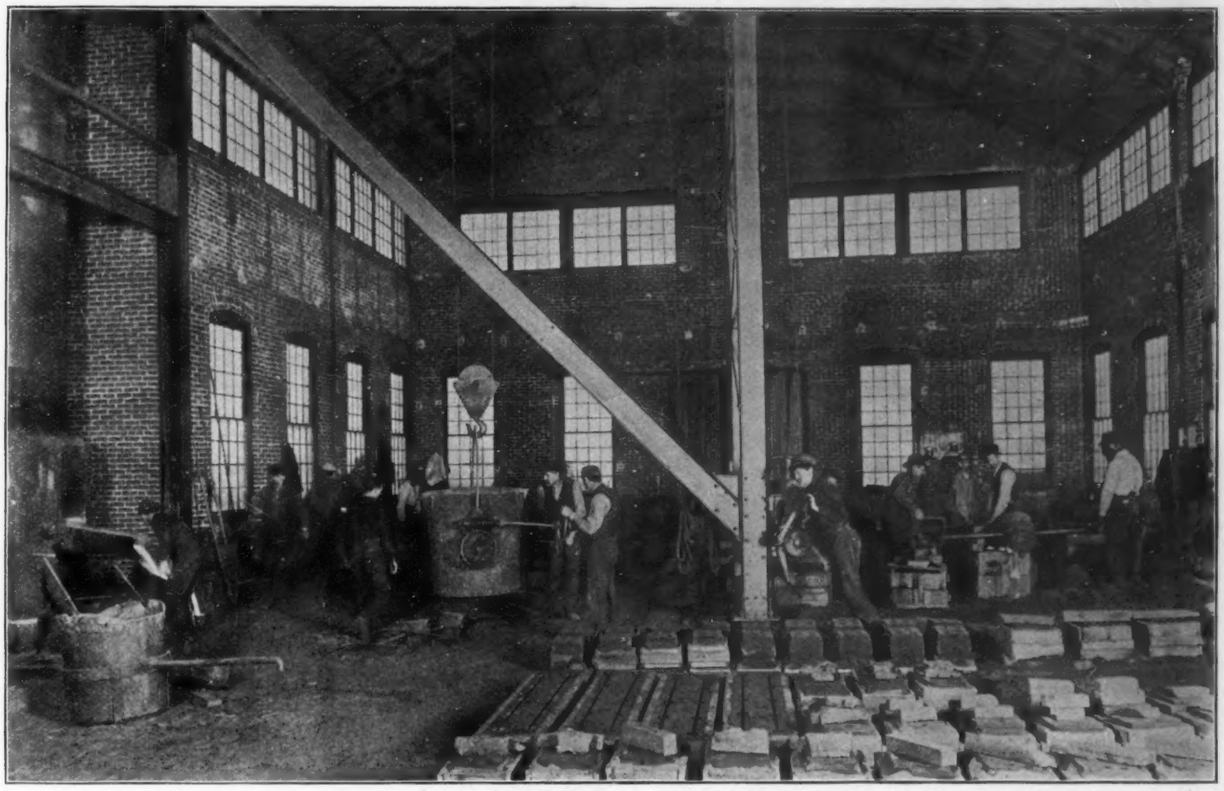


FIG. 1—INTERIOR OF MCHAFFIE FOUNDRY.

Annealing Ovens.

The annealing ovens, four in number, located in a separate building, are shown in Fig. 4. After the castings have been shaken out they are conveyed to the annealing building, where they are carefuly packed in chemically treated roll scale before they are charged into the furnace. The furnaces are 12 feet square, and the inside chamber of each is lined with metal pans made of a mixture similar to that used in the McHaffie castings. For very light castings iron charging boxes are used to prevent the pieces from being lost in the roll scale, some of which is thrown out as waste after each anneal, while a certain proportion is used again with new scale. The temperature required for converting the castings into semi-steel ranges from 1,200 to 1,400 degrees Fahr.

The building containing the furnaces is 60 x 80 feet and adjoining it is a room containing the roll scale, 40 x 32 feet, which contains a storage bin for the scale and a department for treating the scale before it is used.

What is generally known as McHaffie steel is a high grade semi-steel having a tensile strength of 45,000

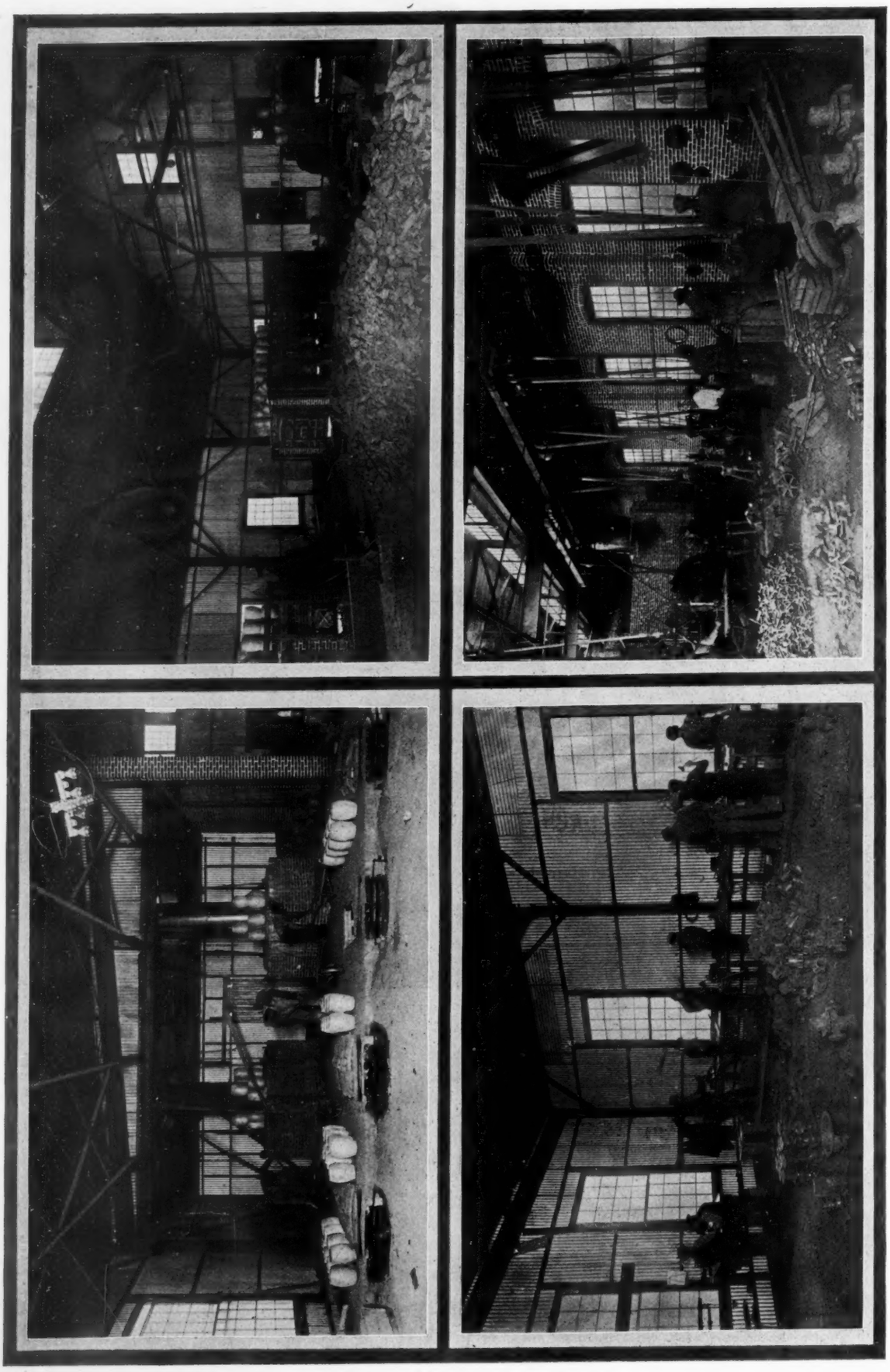


FIG. 4—ANNEALING FURNACES, MCHAFFIE DEPARTMENT.
FIG. 5—FINISHING DEPARTMENT, GRINDING AND FINISHING CASTINGS.

FIG. 2—CRUCIBLE STEEL MELTING FURNACE.
FIG. 3—FINISHING DEPARTMENT—CHIPPING.

to 50,000 pounds per square inch, the metal being uniformly sound, homogeneous, strong and tough, and yet sufficiently soft to machine readily. To facilitate the handling of the bull ladles, the McHaffie department is equipped with a 15-ton jib crane.

Crucible Steel Department.

In its crucible steel department, Fig. 2, this concern is operating two batteries of melting furnaces, each consisting of two furnaces having a melting capacity of eight pots each to the heat, giving a combined maximum melting capacity of 3,200 pounds per heat for the four furnaces. The furnaces are fired with fuel oil, the Maddox improved pan system being used. Owing to the use of fuel oil, special melting pots have been provided by the Jos. Dixon Crucible Co., Jersey City, N. J., which are made of materials adapted to withstand the intense heat to which they are subjected. With proper care they will average from two to three heats, although some have shown even a greater life.

The oil for the furnaces is stored in two tanks of 6,000 gallons capacity each. In the crucible process the highest grades of melting material are used, consisting chiefly of steel punchings, about 100 pounds being charged into each pot. Owing to the use of fuel oil, it is possible to take off the first heat about three hours after charging, the next heat about 1¼ hours thereafter, and additional heats following every hour. A view of the crucible department is shown in Fig. 6.

Cleaning Equipment.

The small castings which are not sand blasted are cleaned in a tumbling mill. This room is 16 x 20 feet and contains a rumbler 40 inches in diameter. The mill is electrically driven and sufficient room has been provided for the installation of additional mills. The finishing department, 80 x 32 feet, shown in Fig. 5, contains all the necessary machinery for cutting gates and risers from the castings and for finishing them before shipment. The cleaning equipment includes two band saw cutting machines, one cold saw cutting machine, planer, shaper, double emery wheel grinders, saw sharpeners, and other necessary tools.

Miscellaneous Departments.

The sand blast room is 20 x 16 feet, air being furnished by a compressor located in the engine room. The cupola house opening into the McHaffie department is 16 x 32 feet and is provided with an elevator for hoisting the melting stock to the charging floor. A commodious pattern shop 25 x 40 feet, has also been provided, equipped with a 36-inch band saw, 16-inch jointer, lathe and other tools, all of the machinery being electrically driven. The power house is 32 feet square and contains in addition to the boiler and engine an air compressor and a blower direct connected to a vertical engine for supplying blast to the cupola. A portion of this room is used for a repair department and contains a lathe, drill press and other tools necessary for making general repairs throughout the plant.

Various grades of crucible steel castings are made by this company to meet the requirements of the trade and by using special melting material in its standard mixture it provides a grade of castings preferred for automobile work which have a tensile strength of 70,000 pounds per square inch. This concern makes a specialty

FIG. 6—INTERIOR OF CRUCIBLE FOUNDRY.

of gears, and gear and worm blanks of either crucible or McHaffie steel.

The various departments of the plant are so located that there is a minimum amount of handling of the castings through the various stages of manufacture from the raw material to the finished product. Although operations were commenced only last August, the output has already exceeded the limit estimated for a plant of this size in this period, and the orders now on the books of the company are heavy, notwithstanding the business depression.

LITTLE CHANGE

Shown in Magnesite Industry in 1906 —U. S. Report.

All the magnesite produced in the United States continues to come from California, but the quantity is not large, since the consumption is limited on the Pacific coast, and the native product can not compete at points of greatest consumption east of Missouri river with that imported from Greece and Austria, owing to prohibitory freight rates from California, reports Charles G. Yale, of the United States Geological Survey for the calendar year 1906. The Porterville, Tulare county, deposits yield most of the crude and calcined material, though a few thousand tons are derived from the Red Mountain deposits in Alameda county. Some calcined material is also sold by the manufacturers of carbonic acid gas, who, however, obtain their crude magnesite from the Porterville deposits. At this latter place there are kilns where the calcining is done. The calcined material is also sold by the manufacturers of carbonic acid gas, who, however, obtain their crude magnesite from the Porterville deposits. At this latter place there are kilns where the calcining is done. The calcined material is mainly used as a digester for wood pulp in paper manufacture, but less is used than formerly, as the manufacturers found they were using more than was really necessary to accomplish the object. For carbonic acid gas manufacture about 800 tons yearly are consumed. The crude magnesite costs in the San Joaquin valley $3 per ton, and the freight to San Francisco Bay is $3 per ton. The calcined sells for a lower price than formerly, and that sold in San Francsico is $14 per ton free on board at factory. The prices for labor and mining are now higher than formerly and add about $1 per ton to the cost of the crude. In the matter of the calcined the variation in the price depends on the amount of roasting given it. That resulting from the work of manufacturing carbonic acid gas does not bring so high a price as that which is specially calcined and given a longer roast at a higher heat.

The total domestic output of crude magnesite in 1906 was 7,805 short tons, valued at $23,415, an average of $3 per ton, as against 3,933 short tons, valued at $15,221, in 1905. Most of this was roasted, resulting in 2,864 tons of calcined material for use as a digester for wood pulp and for making brick and building material. This 2,864 tons of calcined material was valued at $40,000, or between $13 and $14 per ton. Some small lots were, however, sold for less prices.

The quantity and value of crude magnesite produced in the United States in the year 1891-1906 is as follows:

	Short tons.	Value.
1891	439	$ 4,390
1892	1,004	10,040
1893	704	7,040
1894	1,440	10,240
1895	2,220	17,000
1896	1,500	11,000
1897	1,143	13,671
1898	1,263	19,075
1899	1,280	18,480
1900	2,252	19,333
1901	3,500	10,500
1902	2,830	8,490
1903	3,744	10,595
1904	2,850	9,298
1905	3,933	15,221
1906	7,805	23,415

The plant at Sessions Basin, East Oakland, owned by the American Magnesite Co., was badly damaged by the earthquake of April, 1906, though the machinery was not much injured. The buildings were not restored much before the close of the year. For this reason little was done in the way of manufacturing magnesite bricks or building material in 1906 in California.

Since the close of the year a new deposit near Cloverdale, Sonoma county, has been opened, and a few hundred tons of crude material have been shipped. A road is being built to another deposit near Guerneville, Sonoma county, which is being opened. Also since the close of the year a deposit has become productive near Exeter, in Tulare county, about 20 miles from the Porterville deposits. The California Magnesite Co. has been organized to develop magnesite deposits near Winchester, in Riverside county; the headquarters of the company are in Los Angeles. Thus far no output has been made. With these exceptions there is nothing new to record as to magnesite mining operations in California. Many other deposits are known—some of them of considerable value—but the small local demand and the impossibility of shipping eastward and in competition with the cheap imported article prevents any extensive mining operations being inaugurated.

Somewhat extensive experiments are being conducted in California in the manufacture of tiles partly formed of calcined magnesite. The producers are in hopes that their experiments will prove successful, as the manufacture of these tiles will cause a more decided demand for magnesite. It is also the hope of the producers that the increasing use of open-hearth furnaces will cause a large demand for the mineral, which is used in the form of ground calcined plaster for lining.

Magnesite Imports in 1905 and 1906.

	1905		1906	
Magnesite—	Quantity.	Value.	Quantity.	Value.
Calcined, not purified	134,595,334	$575,355	141,314,682	$740,585
Crude	14,152,466	63,264	39,477,766	122,908

Magnesite Imports.

The imports of magnesite into the United States for 1905 and 1906 in pounds were as follows:

United States Consul W. A. Rublee, of Vienna, Austria, states that the export of calcined magnesite to the United States from the Vienna consular district alone amounted to 53,000 tons net weight. He says also that at present the Veitscher Magnesitwerke Actiengesellschaft is the principal company operating magnesite mines in Austria and is enjoying extraordinary prosperity.

His statement in part is as follows:

Magnesite was discovered in the province of Styria, Austria, in the early eighties by Carl Spaeter, of Coblenz, Germany, who had acquired some property near Veitsch, Styria, which was supposed to contain manganese ore. In the course of exploiting this property the yield of manganese was not found to be satisfactory, but another substance was discovered which turned out to be valuable for fireproofing purposes and was later called magnesite owing to its high percentage of magnesia.

The first magnesite was produced in small quantities in 1890, but its production on a large scale began in 1892, when shipments were first made to the United States. In 1897 the Veitsch property was organized into a stock company with 2,000,000 crowns ($406,000) in preferred shares and 6,000,000 crowns ($1,218,000) in common shares, the preferred shares to pay 7½ per cent interest guaranteed. This dividend was soon advanced to 10 per cent and has been paid on preferred and common shares alike for several years past. Carl Spaeter retains the controlling interest in the company.

EMINENT MEN OF THE IRON WORLD

VI. James M. Swank.

By B. S. Stephenson.

On Jan. 1, 1908, James M. Swank rounded out 35 years of service for the American Iron and Steel Association, first as secretary, and, since 1885, as its general manager as well. His life has been an active one, crowded with incident, and most men of like age and achievements would long ago have been content to enjoy a well-earned leisure. But the iron and steel industry has ever been noteworthy for the sturdiness of its leaders. Every day still finds him at the offices of the association, busied with the same multitude of duties which have been his sole work for thirty-five years.

Through the greater part of its existence, the Association has made its home at No. 261 South Fourth street, in a historic section of Philadelphia, where the fine old residences of an earlier day have reluctantly given way to the demands of business. The offices, which occupy two floors, are quiet, and cool, and roomy, with lofty ceilings and comfortable furnishings. Mr. Swank's favorite place is before a large, antique table, piled high with books and papers and with a correspondence that is world-wide. Here in days gone by he has received and consulted with the nation's tariff leaders,—McKinley, Quay, Wharton, Kelley, Randall, Carey, Dr. Elder, Reed, and countless other statesmen, editors, and men of prominence in industrial affairs; here he has framed tariff arguments to fit a multitude of situations and prepared a variety of tracts which have circulated by the millions; and here, too, he has directed the collection and publication of statistics recording the unparalleled growth of iron and steel making in America.

Made Secretary in 1872.

It was in 1872 that the American Iron and Steel Association, looking about for a secretary, settled upon Mr. Swank as one well qualified by character and training for the position. He was then a man of forty, and had had a varied career. Taken at the age of seven by his parents from his birthplace in Westmoreland county, Pa., to Johnstown, he had received a common school and academic education and had spent a year at Washington and Jefferson college. Before he was twenty he had clerked in his father's store, taught school, studied law for a brief time, and served as editor of a Whig campaign newspaper during the stirring months in which that party in 1852 waged its final and losing battle. Editorial work had appealed to him and the following year he had founded the *Cambria Tribune*, which, later under the name of the *Johnstown Tribune*, he published successfully for many years, (and Mr. Swank is very proud of the fact that the little weekly journal which he originated is today one of the most important dailies in that section of Pennsylvania). Afterwards his political activities had taken him to Washington, for a time as clerk of the House committees on manufactures and agriculture, and later as chief clerk of the Department of Agriculture.

The Association needed a man with journalistic training, with a Washington experience, and a knowledge of political affairs, one in thorough touch with the activities of the times, acquainted with statistical methods, and possessing the ability to plan and organize. Mr. Swank had all these requisites. In addition, he was Pennsylvania born and bred—as his ancestors for four generations back had been,—and had grown up in the center of one of the state's most important iron sections, where ample opportunity was afforded to study the conditions and needs of that still struggling industry. He had seen the stifling effects of the purely revenue policy in force from 1846 to 1861 and was familiar with the vacillating tariff history of the country. Moreover, he knew the devious methods of congressional legislation and enjoyed the acquaintance and friendship of many men of influence.

Iron and Steel Owe an Unpayable Debt to Swank---Andrew Carnegie

By David Reeves.
President Phoenix Iron Co.

It seems to me his conspicuous ability to respond to the many demands of congress with accurate figures and information during the formative period of protection legislation entitles Mr. Swank to the most profound thanks of the community. The statistics of the iron trade which he has formulated and brought down from the beginning of things to the present time will always stand as a monument to him.
Philadelphia.

Discouraging Beginnings.

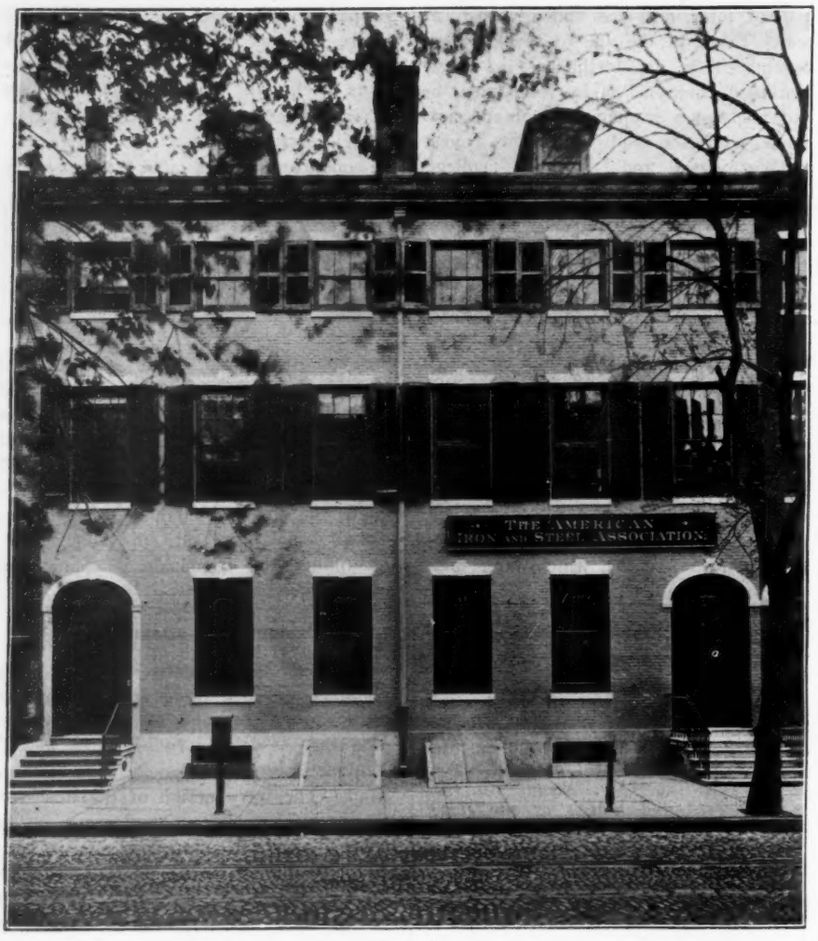
For one so eminently qualified there could be no such thing as refusing, and on new year's morning of 1873 he walked into the Association office, then at 522 Walnut street, just opposite Independence Hall. The introduction of the new secretary was anything but pleasant. "The office," says Mr. Swank, "was a large but poorly-furnished and poorly-kept room. A more uninviting place in which to hang up one's hat and begin to put figures together, and frame tariff arguments, and compile the news of the domestic and foreign iron trades can scarcely be imagined." This hardship was overcome early the next year when the Association headquarters were removed to their present location. A more serious difficulty, however, was found in the sadly inadequate equipment to which the new secretary fell heir. In 1859, fifteen years previous, when the organization still found the name "American Iron Association" sufficiently comprehensive, its secretary, Prof. J. P. Lesley, compiled and published what was called "The Iron Manufacturers' Guide to the Furnaces, Forges, and Rolling Mills of the United States." This was a monumental work of some 800 pages, illustrated with elaborate maps and thor-

[1]Other biographical sketches in this series are as follows: 1. John Fritz, Feb. 28, 1907; 2. Joseph Wharton, April 4, 1907; 3. Frank J. Hearne, July 4, 1907; 4. Hugh Bell, Aug. 8, 1907; 5. John J. Spearman, Sept. 5, 1907.

oughly complete at that time. But industrial changes are rapid and the fifteen years intervening had robbed the Lesley directory of all value for statistical purposes.

The First Statistics.

"I discovered that the office possessed no list of the existing iron and steel works of the country," said Mr. Swank while discussing his early difficulties, "and this discovery revealed the additional fact that full and accurate statistics of the annual production of these works could not be obtained until a complete list should be compiled. More than a year elapsed before we were able to complete this task—so many and so formidable were the difficulties to be overcome." By Nov., 1873, however, the Association was able to publish the blast furnace and rail mill production of the previous year, and about the same time brought out a slender volume listing the blast furnaces and rail mills. The production figures formed the first volume of the Annual Statistical Report, which has since appeared about mid-summer of each year without a break and is now in its thirty-third volume, a compact little volume of close to one hundred pages, crowded with accurate information on all the diverse branches into which the iron and steel trade of later years has been divided. The list of furnaces and rail mills was the original volume of the "Directory to the Iron and Steel Works of the United States." Sixteen editions have been published and the seventeenth, a volume of about 500 pages, will be brought out early this year. Those in the industry can bear witness to the inestimable value of the up-to-date, always dependable information contained in these volumes.



OFFICE OF THE AMERICAN IRON AND STEEL ASSOCIATION.

Editing the Bulletin.

There is a wise saying to the effect that "once a newspaper man never anything else," meaning merely that the fascination of the craft will endure with one who has tasted of its experiences. Mr. Swank in his early life had some fifteen years of editorial joys and sorrows to his credit, and, though years had elapsed when he took up the association work, he found there something after his own heart,—*The Bulletin,* a little eight-page weekly, chiefly devoted to the presentation of reports on the iron and steel markets at home and abroad. This had been in existence since 1856, being a part of the heritage from the old American Iron Association, and had contained some valuable statistical matter in the palmy days of the original association, rising to the dignity of regular appearance in 1866. This journal the association wanted improved,—which was quite to the new secretary's liking—but he was also given to understand that its size and cost were already sufficiently large. This latter was not so much to his liking, but the publication was immediately improved, and to a marked degree, and to this day has proven one of the most effective and valuable departments of the association's work. At the beginning of 1874 the paper was slightly enlarged to its present form. In later years, because of the increasing attention demanded by the other publications, its publication was changed so as to appear only three times a month and since the beginning of 1898 it has been published only twice a month. Mr. Swank has personally "made-up" almost every issue. It has ever been a bright, interesting little paper, presenting a wide range of descriptive, historical, biographical, and statistical matter connected with the industry. It has always found room for the publication of the opinions on timely topics of those whose opinions are worth while, the editor supplementing these with his own views when necessary. He has been a constant and vigilant agent in the defense of the protective tariff system.

Swank the Historian.

Even though without other claim to recognition, Mr. Swank's work as a historical writer would assure him a place among men of achievements. In the editor there is always a latent spirit of authorship, and with Mr. Swank this manifested itself after only a brief residence at Washington, when in 1872 he brought out his "History of the Department of Agriculture." Shortly thereafter he became identified with the iron and steel industry, and here his fondness for things historical soon directed his attention to the lack of any dependable records of early iron-making in America. Furthermore, the pioneers in the industry were passing away, and he saw that it was a matter of only a few years until their struggles and accomplishments would have passed into oblivion. This was the immediate inspiration of his volume appearing in 1878, entitled "An Introduction to the History of Iron Making and Coal Mining in Pennsylvania," and six years later this was followed by a more ambitious and comprehensive work, "Iron in All Ages."

It chanced that Mr. Swank was com-

By Joseph G. Butler Jr.

I have known Mr. Swank covering the entire 35 years of his connection with the American Iron and Steel Association. His services to the iron and steel interests have been invaluable and to a certain extent appreciated. His figures no one ever thought of questioning. I believe the full appreciation of his work will increase as time rolls on.

As a statistician, I do not think he has a superior on the face of the globe. I have had a great deal to do with Mr. Swank in one way and another and I always found him the same kind, congenial, considerate man. I remember that when I appeared with others before "the ways and means committee" years ago, when we were all fighting for existence, none of us thought of going to Washington without having Mr. Swank at our elbow. We depended entirely upon him for facts and figures and many of his promptings and suggestions went before the "ways and means committee" and were adopted.

The late President McKinley was Mr. Swank's devoted friend and depended upon him for a great deal of statistical information.

Aside from Mr. Swank's devotion to the iron and steel interests, I have always been impressed by the clearness of his writings. His little book "Our Nearness to the Revolution" is a classic and is a mine of information. Readers of the Bulletin of the American Iron and Steel Association will recall how frequently Mr. Swank alluded to this patriotic subject.

Youngstown, O.

missioned by Gen. Francis A. Walker to collect the statistics of iron and steel for the census year 1880. When his final report was made the following year, he accompanied the statistical section with a historical sketch of iron-making back to Colonial times, reviewing its manufacture in all countries, but more minutely in each state and territory from the beginnings of the industry. The mass of information thus preserved was later considerably increased and the whole was published in 1884 in book form as "Iron in All Ages." Another edition, greatly enlarged, appeared in 1892.

In December, 1897, at the end of a quarter century in the Association's service, Mr. Swank published and distributed to its members an interesting little souvenir volume entitled "Notes and Comments on Industrial, Economic, Political, and Historical Subjects" being principally made up of the more important tariff articles appearing from time to time in the *Bulletin*. He has now almost ready for publication a large volume entitled "Progressive Pennsylvania," in which the industrial development of the Keystone State to the present time will be exhaustively reviewed. In recognition of his literary work Washington and Jefferson College in 1900 conferred on him the honorary degree of Ph. D.

Defending the Tariff.

No list of Mr. Swank's writings would be complete if it did not include reference to his literary efforts in behalf of a protective tariff. In the earlier history of the Association this was perhaps its most important work, and to Mr. Swank, among many resulting duties, fell the task of compiling arguments to combat the claims of a vigorous opposition. The history of tariff legislation furnished ample material and Mr. Swank was tireless in its presentation. Tracts were prepared by the hundred, and they were circulated by the millions. In his private office today there is a row of large volumes in which is preserved a single copy of each of these pamphlets. They represent in part the product of sixteen anxious years, from 1872 to 1888, during which congress was swamped with a steady stream of bills aiming to reduce the tariff on iron and steel, while the industry always faced the prospect of a return to the crushing foreign competition of its early days.

Mr. Swank entered into this work of defense with a zeal born of the conviction that one's cause is just. He had seen the iron industry of the whole country halt and wane because of the vacillating tariff policies of the times, and he had firm faith that it could be built up to an important position only by a schedule of duties sufficiently high to prevent ruinous competition from abroad and so steadily maintained as to give manufacturers the courage necessary for any industrial advance. From the first the friends of protection in congress relied upon him for accurate information. More than that, he represented the iron and steel manufacturers in every tariff campaign at Washington after he became secretary. "Representing" these interests meant that he virtually *managed* their part of all tariff controversies involving congressional legis-

By William Metcalf.

It is unnecessary to dwell on his great and continuous good work; all the world knows of that. I have known Mr. Swank for about 40 years, and I only know him as a genial, consistent, earnest Christian gentleman, a credit to his country and a pleasure to his friends. I hope he may enjoy many years of the healthy, happy old age he deserves.

Braeburn, Pa.

By John Fritz.

I became connected with the Cambria Iron Works, at Johnstown, in June, 1854, and soon after made the acquaintance of Mr. James M. Swank, then a young man. During the time the improvements were being made in the plant he frequently visited the works and was much interested in what was being done. As the first great improvements in rolling mill practice were made at the Cambria works in Johnstown, it can be said that he has been contemporary with every improvement that has been made in the iron business within the last 53 years, during which period most marvelous results have been obtained. Mr. Swank took a lively interest in the iron and steel industry, and in early life was connected with a newspaper. Both his interest in the iron industry and his connection with the press served as a preparatory training for the important position in which he was afterward placed, and which he has filled so long and so ably, his statistics being quoted the world over. For the important work he has done, the iron and steel manufacturers and also people at large are greatly indebted. Mr. Swank is an able man, and he is as modest as he is able. To know him intimately is to respect him. He is a stranger to deceit and stands for all that is fair between man and man.

Bethlehem, Pa.

lation; in short, he has been the politician of the Association for 35 years, and in all that time the Association has never lost a tariff battle.

His Personal Side.

Turning to the personal side, Mr. Swank is the most genial of men. Above medium height, straight and spare of person, his appearance is anything but that of one who last July passed his seventy-fifth milestone. His memory is a storehouse of historical facts. His love for books has built up the association's library from a modest collection of three volumes when he became secretary to a complete collection of works of reference and has lined the walls of his "den" with a well chosen private library,—including many exceedingly rare volumes,—chiefly on historical subjects. About his "den" walls are many framed autograph letters from notables, and the Association offices contain a collection of interesting portraits.

If Mr. Swank has hobbies, they are two—accuracy and good printing. Of the Association publications he says: "In all that we have printed, of whatever character, we have aimed to be first of all accurate. Our statistical statements always add, and we never say pounds when we mean tons." And there is ample evidence that this striving for accuracy has been appreciated, for the government has relied upon the association to collect census statistics covering iron and steel production for the last three decades. This has naturally been a source of pride to Mr. Swank, but he has other reasons for gratification. To the writer he said recently: "If there is anything that I am proud of in looking back over thirty-five years of continuous service in this office it is the good style of all our publications—the arrangement of the matter contained in them, their uniformity, and their neat typographical appearance."

Recorder and Historian.

Mr. Swank has frequently been referred to as "the recorder of the iron and steel industry." "Recorder" he has been, and historian as well, but these terms but partially cover his labors in its behalf. From the first the Association has stood for the industry, and Mr. Swank has stood for the Association. The secretary of an organization usually performs duties that are assigned him, but in this case he has ever been an executive officer, looking after all the varied interests of the Association, including its membership, its finances, its tariff controversies, and its relation to other industrial organizations. Hence there is no exaggeration in saying that, by virtue of his position, he has been the inspiration for much of the industry's progress, and that his pen has played a stimulating part in the wonderful advance which it has been his privilege to record. Why he has done his task so well is not a mystery.

"I believe," he said recently, "in centering one's energies on one important line of work and then keeping relentlessly at it."

Mr. Swank now has seven clerks to assist him in his work. He has always frankly acknowledged his obligations to his assistants, mentioning many of them by name in the annual statistical reports.

History of the Association.

The American Iron Association was organized in Philadelphia on the 6th day of March, 1855, over 52 years ago. Hon. George N. Eckert, of Reading, Pa., was chosen president; General James Irvin and John H. Towne, vice presidents; Charles E. Smith, treasurer; and J. P. Lesley, secretary. The office of the Association was established at Philadelphia. The Association thus organized continued in active existence until 1859, during which time much valuable work was done by it. "The Iron Manufacturers' Guide to the Iron Works and Iron Ore Mines of the United States," compiled by the secretary, Professor Lesley, was a work of which the American Iron Trade stood in great need and of which it had and still has just reason to be proud. It was published in 1859 and contained about 800 pages.

Five years later the Association was re-organized and its name enlarged to the American Iron and Steel Association. This action was taken at a very large meeting of manufacturers from many states which was held at the Board of Trade rooms in Philadelphia on Nov. 16 and 17, 1864. The office of the Association was established at Philadelphia and the following permanent officers were elected: President, Captain E. B. Ward, of Detroit; vice presidents, Samuel J. Reeves, Abram S. Hewitt, James M. Cooper, Charles S. Wood, and Joseph H. Scranton; treasurer, Charles Wheeler; secretary, Robert H. Lamborn. Captain Ward remained president until Feb. 18, 1869, when he declined a re-election and was succeeded by Samuel J. Reeves, of Philadelphia. Mr. Reeves continued to be the president of the Association until his death on Dec. 15, 1878. He was succeeded by the Hon. Daniel J. Morrell, of Johnstown, who was elected March 6, 1879, and resigned Dec. 15, 1884, owing to ill health, and died on Aug. 20, 1885. Mr. Morrell was succeeded as president by B. F. Jones, of Pittsburg, who was elected Jan. 6, 1885, and died on May 19, 1903. Mr. Jones was succeeded as president by Joseph Wharton, of Philadelphia, Jan. 1, 1904, who is the present official head of the Association.

From 1864 to 1907, a period of 43 years, the Association has had only five presidents. From 1864 until his death on Jan. 18, 1903, the Hon. Abram S. Hewitt continuously served as one of its vice presidents. Another vice president, Mr. Wharton, served from 1875 until his elevation to the presidency in 1904. Still another vice president, William Metcalf, has served since 1884.

A NEW SOLDER FOR ALUMINUM.

A new aluminum solder which is strong and durable and has a low fusing point and which also unites easily with aluminum, has just been patented by Carleton Ellis, Boston. It consists of an alloy of tin and zinc, aluminum and manganese, tin being the constituent used in the greatest relative amount. The manganese is added only in relatively small quantities. The later ingredient is used to improve the texture of the alloy and to increase the durability of the soldered joint. Chromium may be added if desired. Suitable proportions for a satisfactory solder should contain tin, 30 parts; zinc, 7 parts; aluminum, ¾ part; manganese, 1/10 part. Using chromium with manganese the mixture should contain tin, 30 parts; zinc, 8 parts; aluminum, 1 part; manganese, ¼, and chromium, 1/16 part.

VANADIUM AND AUTOMOBILE CYLINDERS.

One of the most serious features of deterioration in cars is the loss of compression through the wearing of the cylinders. Foreign engine castings always have been superior to any American product in this respect, but few have understood why. Light has been thrown on the subject recently by some experiments made by the American Locomotive Automobile Co. It was found that the inside of the cylinder castings obtained here will take a polish from the piston action quite readily, but that very soon after the inside polish has reached its best, it begins to check and crack away, leaving roughness. To this is due the loss of compression. Some imported Berliet cylinders, tried under the same conditions, took higher polish and held it, the compression showing no loss after long service. The fact that the Berliet castings have a considerable percentage of vanadium is believed to partly explain the difference.—*Graphite.*

THEORY AND PRACTICE OF SHOP AND FACTORY MANAGEMENT[1]

By Oscar E. Perrigo.[1]

The object of manufacturing is the production of goods required for market at such a cost that they can be sold at a price sufficient to yield a fair profit over and above the cost of the material of which they are composed, the labor necessary to make them, and all contingent expenses incident to their production and sale.

The theory of manufacturing is the conception and elaboration of the scheme of organizing and carrying on the business of manufacturing, the component parts of which scheme are founded upon inferences drawn from principles or previously known and demonstrated facts. The working out of this theoretical scheme must necessarily include the plans for building and equipping the plant, the purchase of material, the management of the various shops, and the advertising and selling of the product.

The practice of manufacturing necessarily covers the actual management of the plant when erected and equipped, the direction of the purchase of material, the routine work of the shops in performing the manufacturing operations, and the various agencies by which the manufactured goods are advertised and marketed.

To produce valuable and successful results the theories formulated for the establishing of an industrial enterprise must be based upon accurate knowledge of natural laws and all the factors going to make up the manufacturing problem and its conditions and processes; an accurate knowledge of the raw and partially manufactured material entering into the work, its character, production and market conditions; the handling of this material and its conversion into manufactured goods, including the machinery best adapted for these purposes, the kind and quantity of power most suitable for driving it, its capacity of production, the kind and cost of the labor to operate it and keep it in repair, the management of that labor so as to produce the highest degree of efficiency, the cost to house this machinery and to protect it from fire, and the charges for taxes, insurance and maintenance; the conditions of the market for the goods made and their relation to other similar product or such nearly related product as may influence its price or come in competition with it; the best methods of advertising and giving publicity to the business and stimulating interest in it; and finally all the conditions of its actual sale at profitable prices.

It is easily seen that the problem is a complex one and that the best results can only be obtained through the operation of such a system as will be in accordance with all the conditions mentioned in this brief outline, many others that will be self-evident, and still others that will develop in the course of practice. While many factors enter the formulation of such a system it must be so designed as to be one harmonious whole, each portion filling its allotted sphere in the working out of the general results.

It will usually be found exceedingly difficult for the manager who must once or twice in a lifetime, go through with the investigation and study necessary to satisfy himself that he is sufficiently well informed to undertake this work, and he will be wise to seek the advice of experts who make these matters their special work and have all the data as well as much valuable practical experience to draw upon. Such a man will be able to make a special study of the local conditions and present the whole subject in such a clear manner as to bring out its features in proper form for the discussion from the capitalist's point of view, and to carry it through to a successful completion.

The plan of the organization of the working force of an industrial establishment naturally precedes the discussion of methods by which it is to be handled. Assuming that the organization is a stock company with the usual elective officers; that the output is to be machinery, and that this product is to be sold through local agents, the plan will be substantially that shown in the chart given herewith. The three principal divisions of the plan as here laid out are: The capitalization of the enterprise, and the formation of the stock company for carrying on the business; the organization of the plant for manufacturing; and the selling department for advertising and marketing the product.

The capitalists or stockholders are represented by the board of directors, who exercise supervisory control over the elective officers of the company, usually a president, secretary and treasurer, either of whom, or some other suitable person is selected for the position of general manager, who acts under similar authority, and as his title indicates, has the general management of the two great branches of the business, manufacturing and selling, each under a responsible head, the former under the factory manager (sometimes called the works manager, and in smaller establishments, the superintendent) and the latter under the sales manager.

Under the factory manager will be a considerable office staff consisting of the purchasing agent, whose duties it will be to keep in close and constant touch with the market and to make all contracts for the purchase of materials and supplies and to buy such in the open market as are conveniently handled in this manner. The store keeper will receive and receipt for all material and supplies of whatever kind coming into the plant and have charge of their care, storage and issue, whether located in the store room proper, the warehouse, the shops or the yards, and see that none are used unless regularly issued on authorized requisitions and charged against the proper accounts.

The production engineer will have charge of planning the shop operations and systems for performing work, and the routing of it through different departments. Also the time studies upon these operations and the time schedules made from them. Connected with this department is the time clerk and the cost clerk.

The factory manager has as his executive officers the superintendent and assistant superintendent, the former having general charge of manufacturing operations, and particularly of the work of the following departments, viz., drafting room, or engineering department, pattern shop, iron and brass foundries, forge shop, tool room, experimental room, carpenter shop, paint shop, and the shop and yard transportation departments. This latter department is sometimes called the "yard gang," but from the nature of the work it should include all similar work in and about the plant. The power plant, heating and lighting, care and maintenance of grounds and buildings,

[1]Fourth of a series of articles on cost keeping and shop maangement.

fire protection, sanitary system, etc., will also come under his charge.

The assistant superintendent, sometimes called the master mechanic, has charge of the manufacturing departments of the machine shop, which will usually include the work of planing, heavy turning, drilling and boring, milling and gear cutting, small parts making, including the lighter machines for this purpose; grinding and polishing, usually divided into two rooms from the nature of the work, but under one foreman; the finished parts store room, from which the smaller parts are drawn for assembling; the assembling room, where small and medium sized parts are put together; the erecting floor, and the inspection department, including testing.

The sales manager will have a staff including an engineer assisted by draftsmen who will handle preliminary work, prepare tentative plans, make estimates, etc., a shipper who has charge of all shipping but not of preparing goods for shipment; a chief bookkeeper, with the requisite assistants; an advertising manager in charge of the publicity department and a general sales agent. This official is in charge of the district sales agents, when the extent of territory covered by the sales renders it necessary, and these in turn control the local agents. If the product of the establishment is to be sold principally by traveling agents this portion of the plan will be modified accordingly.

By this plan there is a proper division of responsibility and the individual responsibility of each and every official, and the limits of his authority are clearly defined and understood. Responsibility should not be laid upon any official without at the same time conferring upon him the proper authority for performing all acts and giving all the orders necessary to the full and complete discharge of that responsibility.

Having now a proper system of organization arranged it will be appropriate to discuss some of the questions of practical management.

Human nature is pretty much the same whether we find it in the college, the army, the workshop or the fields of business. It is the leader who succeeds. The success of Gen. Sheridan in the valley of Virginia, following the failures of several others, was no greater than that of Andrew Carnegie in the great steel industries. Both succeeded because they were leaders, and as the latter once said, "because I got men around me who were cleverer than I was," although the cleverness seems to be particularly prominent in the getting of men. The building up of an organization of good men, each assigned to the duty for which he is personally the best equipped and adapted, requires a high order of ability, the possession of which goes far toward achieving success. The administrative ability to lead and direct such a force will be a very large factor in the successful carrying on of any industrial enterprise. And when these two qualities are found in one man his value can scarcely be reckoned in dollars and cents.

Such a man will secure a spirit of loyalty on the part of every one connected with the concern. His knowledge of human nature will give him an insight into the individual characteristics of officers and men, and by this knowledge he will know the best methods of dealing with each. "Good officers make good soldiers," and his subordinates realizing his success will not be slow to learn his methods and make use of them, and through these subordinates these methods will gradually but surely permeate the entire force. There will be a feeling of confidence in his leadership that is of incalculable value in the efficiency of the organization and the fact that he has planned a certain matter will give it a prestige that will go a long way toward insuring its success.

While it is always desirable that the manager and his assistants should show proper interest in and appreciation of the workmen, it is well not to carry this too far in the direction of what might be termed paternalism. The American mechanic of today simply wants what is generally understood as "a square deal." He does not want something for nothing or to be made to feel that he is provided with extra advantages, social or otherwise, as a gift from the management. He is independent; wants to pay for what he gets, and his self-respect is hurt if some of the good "betterment work" is thrust upon him "without money and without price," and with what he should know is with the best intentions and kindly consideration. Of course this should not be so, and the time may come when the workman may see these matters in a different light. It is hoped that they will; but just now it is as well for both sides if good intentions are not carried so far as to be suspected of some ulterior motive, as has been sometimes, unfortunately, the case.

But let the qualities of the man at the head be the reverse of these; a *driver* rather than a *leader;* a man who formulates his policies without regard for or consideration of the working force by which they are to be carried out; who crowds everything through by harsh measures; who sees only the faults of his men and has no commending words for good qualities, faithful work and efficiency; who is extravagant in that which relates to the conveniences of the higher officials and anxious to cut down the workmen's pay upon any kind of a pretext, and we shall find dissatisfaction, discontent, suspicion, jealousy, wrangling between men and departments and a general air of inefficiency pervading the entire establishment. The faithful few who always try to do the best they can under the most unfavorable conditions will become discouraged and success in any direction will be well nigh impossible. As one foreman remarked when discussing such a condition, "it takes the heart out of the men."

We hear a great deal nowadays about plans and systems for obtaining a high degree of efficiency of skilled workmen; of extending such systems to the special work of operatives and the ordinary work of laborers; of plans for increasing the efficiency of machines; and most of these plans have in them much that is commendable. They are all worthy efforts to realize better conditions, to make the most of the opportunities and conditions under which we are working. But all these good and desirable ends, even if attained, which unhappily they are not, do not insure success of an industrial enterprise.

We must seek out, plan, formulate and apply equally good and practical plans for the manager, and his assistants, his office force; in short, for the business ends of the enterprise, for without a high degree of efficiency here, all the good results of a high shop efficiency may be lost or negatived.

There is, in fact, more real need of efficiency in the business head of the establishment than in the shop, since if there is systematic organization efficiently administered at the head of the concern, it will gradually permeate all departments below it. The reverse is not so likely to result, for the reason that reforms naturally work down the line, not up. The good and efficient system in the shop or in lower departments may be, and frequently is injured, nullified, strangled, by lack

of appreciation of its plans and special features, jealousy towards the originators or administrative officers, lack of earnest co-operation and one hundred and one similar causes, which result in only partial success, or in failure.

While such conditions may prevail under the plans of beginning reforms in the shops, they will be quite different if systematic organization, or reorganization is commenced at the top, in the general office, and from the headquarters carried all the way down the line.

Original plans or needed reforms inaugurated from this point carry with them a weight of authority and prestige possible in no other way. Naturally they call for and receive a degree of loyalty of subordinates in working out their plans and systems to success that cannot be secured if the needed reforms emanate from any other source.

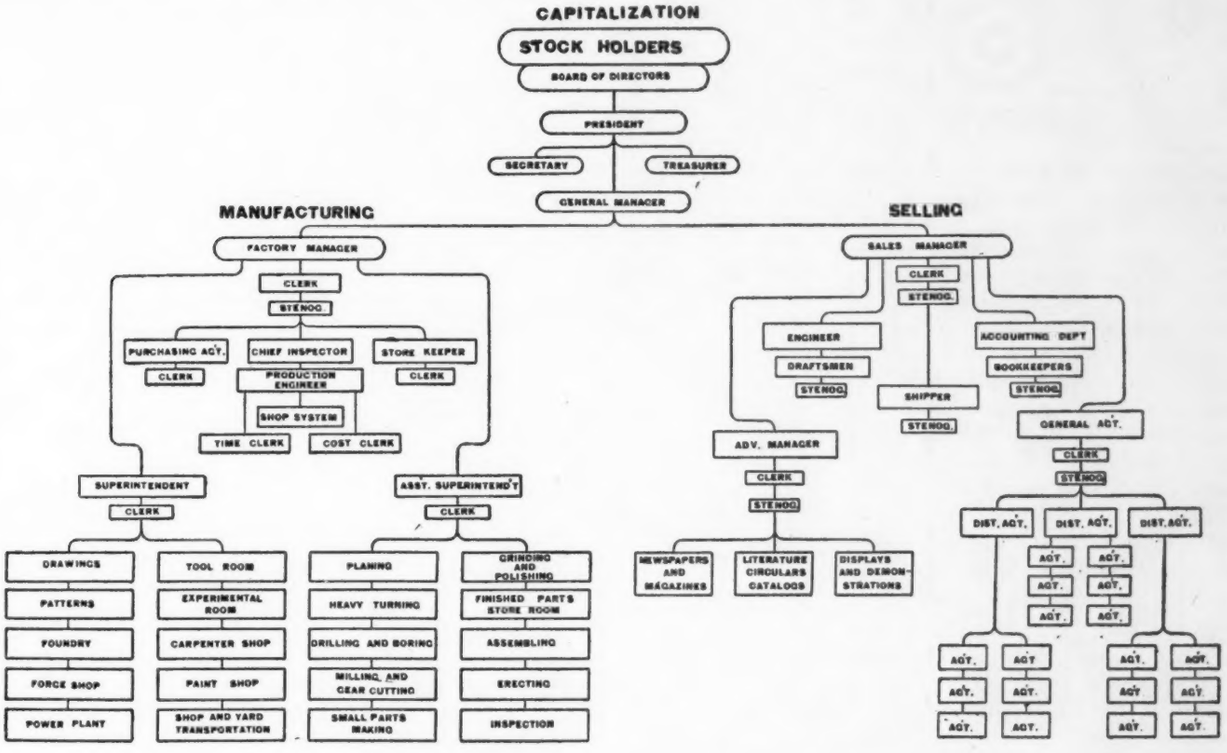
Probably every expert systematizer can recall instances in which the business of a concern was in a condition unsatisfactory to the owners or stockholders and in order to remedy matters an expert was employed, with the tacit consent of the manager. Right here there was trouble at once. The manager considered the employment of an expert as a reflection on his ability. Many of the employes of the concern, loyal to the manager, viewed the matter in the same light. The result was that the expert and his assistants were looked upon more or less as intruders, their work was hampered, correct information was almost impossible to obtain, and their position was very disagreeable. Good results were very difficult to achieve and the best results impossible.

On the other hand, if the owners or directors had called the manager into a conference on the condition of the business, stated quite plainly that results were not satisfactory, and that a change must be brought about in both office and shop systems and modern methods must be adopted, and "put it up" to the manager to employ the expert and his assistants, everybody in the plant would have looked upon them, not as intruders, but as the manager's technical advisers and assistants, and the prestige thus obtained would have been very likely to insure success. If the owners or directors had not sufficient confidence in the manager's loyalty, good intentions and ability to meet these conditions in a manly way, he should have been promptly replaced by a man who would, just as would have been the case with any employe who failed to make good and showed disloyalty when called to account in a reasonable and gentlemanly manner.

All of which tends to emphasize the assertion that reforms must commence at the top and work downward, rather than at any other point, otherwise they generate bad blood and the best efforts and intentions end in failure or only partial and far from satisfactory results.

Therefore if industrial establishments are to be reorganized or reformed we must first labor with the manager or head of the concern and convince him, first, that conditions are unsatisfactory and ought to be improved. Second, that these conditions can be improved. Third, that proper reorganization and systematizing will do it. This will not always be easy to accomplish.

Managers, like other men, have their personal peculiarities and their personal ideals of methods of manufacture. Sometimes these are the result of years of successful management under the conditions prevailing 10 or 20 years ago, and are, very properly, matters of personal pride, and when rudely disturbed by modern innovations, are somewhat painful. To him reorganization means revolution and system means a large increase of clerical force, it means throwing away expensive books, blanks and similar



GRAPHIC CHART SHOWING SYSTEM OF ORGANIZATION OF A LARGE PLANT SELLING THROUGH AGENCIES.

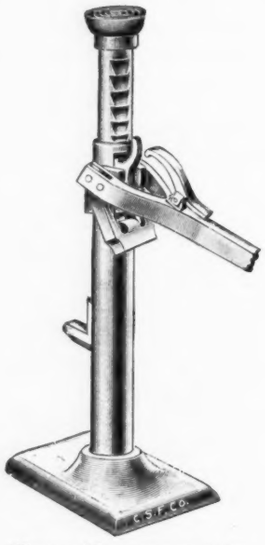
supplies, and the production of many new and strange forms. In fact, it means a large increase of expense, and he now has more expense than the business will stand. And so on through the many arguments that the older school of business men are fond of calling "conservative" ideas as opposed to the radical method of modern business. One expert becoming a little out of patience with the older man's argument, said, "Well, it may be all right when you are wrong to be conservative, but when we are right we can afford to be radical."

The best argument for a management will always be success. The best success will be that which is achieved without injury or prejudice to any of the parties in interest.

One of the most potent factors for insuring success in management is system, properly considered and carefully planned system. The keynote of system should be simplicity. We have in the past few years been wading through a deluge of what has been called system. Some of it has been good, much of it has been useless and unnecessarily expensive. The limits of this article will not permit a discussion of this interesting phase of the question, but it should be recognized by all who have conscientiously studied the conditions that a well planned system whose details are adapted to the real needs of the business, simple enough to be readily followed out by all who are charged with its working, giving all the facts really needed, but not spending money to ascertain facts that will be of little practical value; properly and faithfully carried out, is a most important factor in the successful management of an industrial establishment.

A NEW LINE OF JACKS.

The accompanying illustrations show two of a line of seven jacks adapted to various requirements, and just being placed on the market by the Chicago Steel Foundry Co., Chicago. Fig. 1 represents the heaviest of those tools and is intended for handling heavy machinery, while Fig. 2 shows a jack especially designed for railroad work. These jacks are offered as combining a greater lifting power for a given weight than is possible with a jack differently constructed and corollary with these advantages are features of simplicity and price. The ratchet mechanism has been so devised as to insure certain locking and the impossibility of the tool collapsing at the wrong time. At the same time the release trigger enables the operator to drop the load in a minimum of time. The standards are made of 2-inch steel shell carrying a lifting post of cold-rolled steel. Both jacks are self-contained, have a lift



HEAVY MACHINERY JACK.

of 11 and 12 inches respectively and weigh 35 and 50 pounds, the railroad jack being the smaller. The capacities are 8 and 12 tons and each jack is tested to an overload before leaving the factory. A

RAILROAD JACK.

neat prospectus has been issued by the Chicago Steel Foundry Co. which contains information of interest to users of leverage tools.

CEMENT SHOW

Participated in by Machinery Builders—Some of the Exhibits.

The first annual cement show opened in the Coliseum, Chicago, the night of Tuesday, Dec. 17, and continued throughout the week. It was not only novel but extremely interesting and instructive in the matter of exhibits, of which there were about 80. Most entertaining perhaps were the machinery exhibits, most of which were supplied with power permitting the actual operation of the various devices. A large number of men were engaged in performing routine tasks in the various displays in connection with the demonstration of manufacturing processes.

The American Steel & Wire Co. called attention to the triangular mesh reinforcement it manufactures and had displayed to advantage.

The American System of Reinforcing, 189 La Salle street, Chicago, by whom is manufactured smooth round reinforcing steel formed in spirals or interlacing, arranged its exhibit as the steel would stand in the concrete beams or columns.

The Bethlehem Foundry & Machine Co., South Bethlehem, Pa., exhibited parts and blue prints of cement mill machinery.

The Expanded Metal & Corrugated Bar Co., St. Louis, had an interesting exhibit of photographic plates, mounted in a case with a light behind them so that the negatives were plainly visible showing a variety of construction in which its material had been used.

The General Electric Co. had on exhibition several motors such as are adapted to cement mill work. Among them was a motor right from the mill with the dust still on it.

Robt. W. Hunt & Co., Chicago, are manufacturing a number of devices to be used in connection with testing concrete as attachments to the testing machines. The practical operation of these devices was being demonstrated.

Inland Steel Co., Chicago, exhibited samples of the high carbon, corrugated and twisted bars it rolls at Indiana Harbor.

Calumet Steel Co., Chicago, was represented with a similar exhibit.

Arthur Koppel & Co., Pittsburg, displayed three types of industrial steel cars and also some special trackage for industrial railway equipment.

Monolithic Steel Co., Inc., Washington, D. C., exhibited a line of expanded metal and rod shapes.

THE LARGEST PLANER IN THE WORLD

Built by Niles-Bement-Pond Co. for Mackintosh, Hemphill & Co., Pittsburg

The accompanying illustrations show a planer recently built by the Bement-Miles Works of the Niles-Bement-Pond Co. It has been installed in the shops of Mackintosh-Hemphill & Co., Pittsburg, and has been in successful operation for some time. It is probably the largest metal working planer ever built, having a total weight of 845,000 pounds. Five motors with a total capacity of 207½ horsepower are required for its operation, as follows: Main planer drive, 100 horsepower; slotter drive, 50 horsepower; rail elevating motor, 20 horsepower; head traverse motor, 7½ horsepower; motor for driving air compressor operating the pneumatic clutches of the machine, 30 horsepower. In addition to being a planer a number of other movements have been added, making it practically a universal tool in many respects. Both heads on the cross rail have been fitted with slotter rams, and in addition, the machine may be used for transverse planing. The table is adapted to have a feed ranging from zero to any desired limit for use in slotting. The slotter heads are independently driven by means of a rack on the back of the ram, and have a cutting speed that is practically constant from one end of the stroke to the other, while the return motion is considerably accelerated. By means of the motors and change gears, these speeds can be varied as desired. The transverse planing movement also has a quick return.

The enormous size of the machine can be judged by means of some of the following dimensions: The distance between housings is 14 feet 4 inches; the maximum distance from the table to the bottom of the cross rail is 12 feet 2 inches; the maximum travel of the table is 30 feet. The bed has a total length of 60 feet and a total width of 13 feet; the table ways are each 15 inches wide; the tool slides 7 feet 8 inches and has 4 feet vertical traverse; the cross rail is long enough to admit the full traverse of either head between the housings;

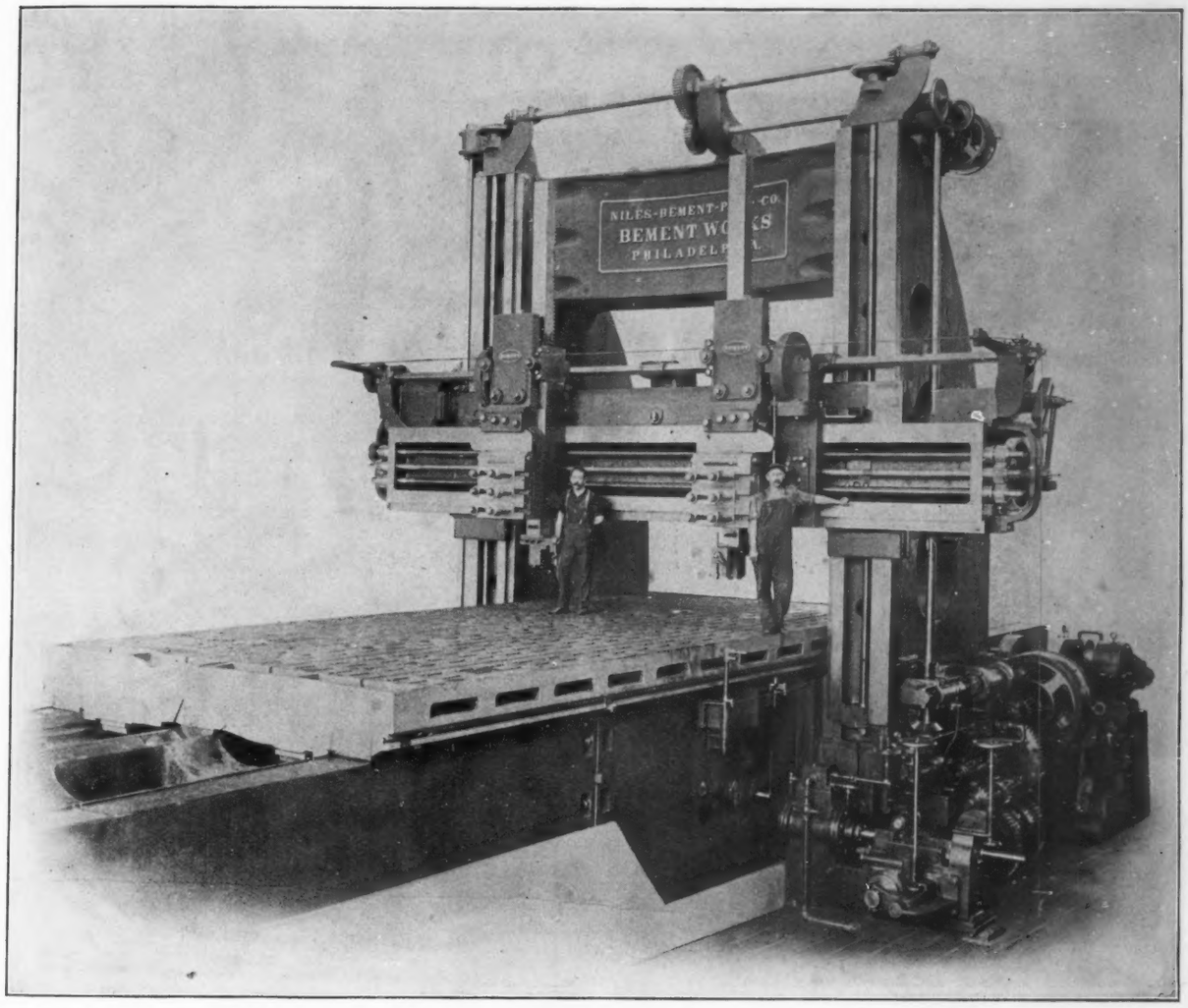


FIG. 1—GENERAL VIEW OF COMPLETED PLANER—SHOWS MAIN DRIVE AND TABLE FEED FOR TRANSVERSE PLANING.

the face of each housing is 2 feet 6 inches and the vertical slide of the cross slide, including the top rib bracing is 5 feet; the slotter ram has a maximum stroke of 8 feet, while there is an additional independent motion to each slotter head of 11 inches.

When it is desired to use a slotting movement or to plane transversely, it is necessary to throw out the regular driving mechanism to the table and connect it to a separate feed motion, to 25 feet per minute with return speeds, respectively, of 52½ to 55½ feet per minute. The same style of drive is used for the slotting motion as for the planing, and gives a cutting speed of 18½ to 30 feet per minute with return speeds, respectively, of 37 and 71 feet per minute. The available cutting speeds for cross planing range from 11½ to 19 feet per minute with return speeds of 35 to 43½ feet per minute. The cross traverse speed and the two end sections into two parts each. The total weight of the bed is nearly 275,000 pounds.

The table is made in two sections divided longitudinally in the center, and has a total weight of about 140,000 pounds. The holes in the table for stop bolts, etc., run entirely through the upper plate. Below this upper plate is a second plate without openings and extending the full width of the table. This serves to prevent all

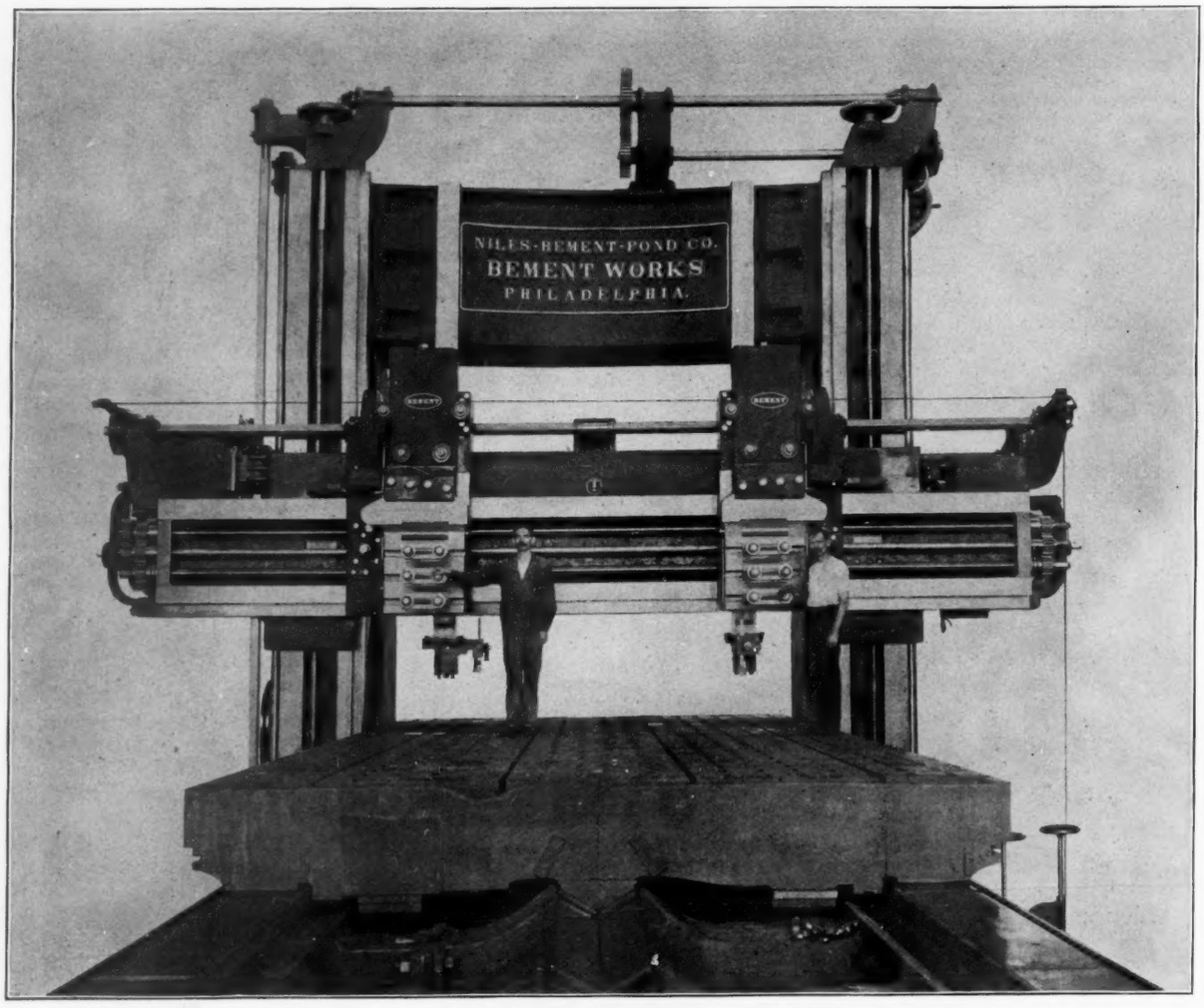


FIG. 2—FRONT VIEW OF PLANER SHOWING BED CONSTRUCTION AND AUXILIARY WAYS.

which will be described later and which, in this case, is entirely distinct from the regular feed motion. The driving mechanism is thrown out by putting the pneumatic driving clutches into their idle position and leaving them in that position.

The cutting and return speeds are made variable through the motor, which has a speed range of 1:1¼. A further range of speed may be obtained by means of change gears. The available cutting speeds range from 14 of the head is 50 inches per minute, while the vertical speed of raising and lowering the cross slide is 26 inches per minute.

Owing to the great weight and the large dimensions of this machine, it was not practical either from a manufacturing or a shipping standpoint to make the bed or table in one piece, and they were, therefore, divided to bring them within reasonable limits. The central section of the bed is divided longitudinally into three parts chips and dirt from falling through on to the ways of the machine. The chips can be removed through the side openings of the table which can be clearly seen in the illustrations, Figs. 1 and 11.

The bed is provided with three ways, two flat ones on either side and one V way in the center. These are clearly shown in the illustration, Fig. 2. Auxiliary ways for the truing up of the main ways are provided. The operation of truing the ways is as

follows. Referring to the illustration, Fig. 2, there will be seen immediately inside and lower than the two flat ways a small flat way on the left and a V way on the right. Cast on the auxiliary ways, and these have been therefore, finished and erected with the closest possible accuracy.

It will be noticed that the table extends down a short distance inside

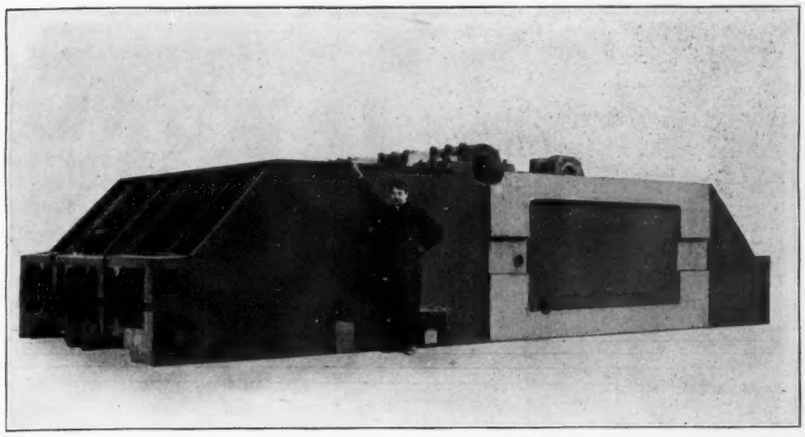


FIG. 3—SECTION OF BED, BOTTOM SIDE UP.

table directly over the main ways are finished pads. These are to carry planer heads for truing up the main ways, when these are worn out of alignment. The table is raised about ¼-inch above the ways and supported in this position on sliding blocks fitting the inner small auxiliary ways, which are used only for purposes of truing. The truing heads being fastened to the end of the table, the ways are planed up from the center to the end. The heads are then placed on the opposite end of the table and the remaining half of the ways finished. Near the center of the bed are pockets in the ways in which these same truing heads may be placed and the table in its turn may be planed in the same manner. The accuracy of this operation depends entirely on the accuracy of the small

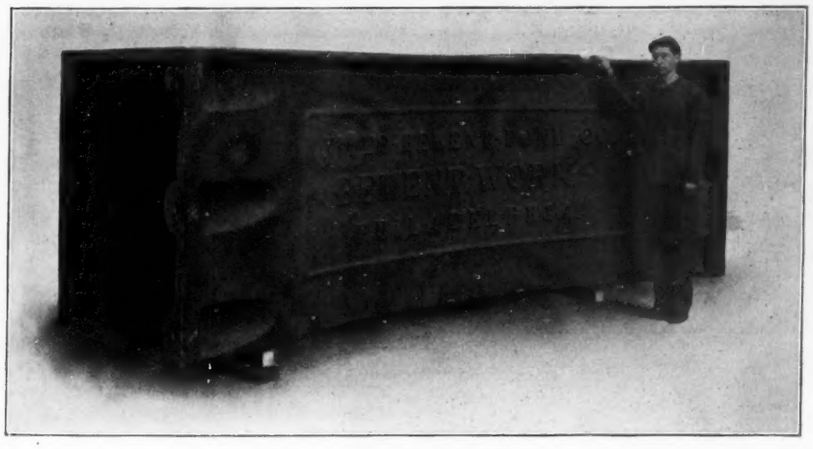


FIG. 4—TIE BEAM OF PLANER.

of the other ways and prevents any possible side movement of the table under heavy cuts. The illustration, Fig. 3, shows the central section of the bed, bottom side up. This section is 73 inches in depth and, as stated before, has been made in three parts divided longitudinally. The illustration clearly shows the key way cut in the end for aligning it with the other sections, which are further held in place by reamed and tapered bolts.

The immense size of the various parts can be judged from some of the illustrations presented herewith. Fig. 5 is a view of the two housings and shows their massive proportions and large bearing surfaces. These housings are maintained in alignment by means of tongues set in the grooves in the bed and which are clearly shown in the illustration. At the top of the housing may be noticed the large cross tie beam facing, the beam itself being practically of this size through its entire length. The illustration, Fig. 4 shows this tie beam, which is made exceptionally stiff and heavy.

The main drive of the planer from the 100 horsepower motor is clearly illustrated in Fig. 6 and is also shown in Fig. 1. Referring to Fig. 6 the operation of the driving mechanism can be explained, as follows: Pneumatic clutches are used for reversing the motion of the table, these being connected to the motor

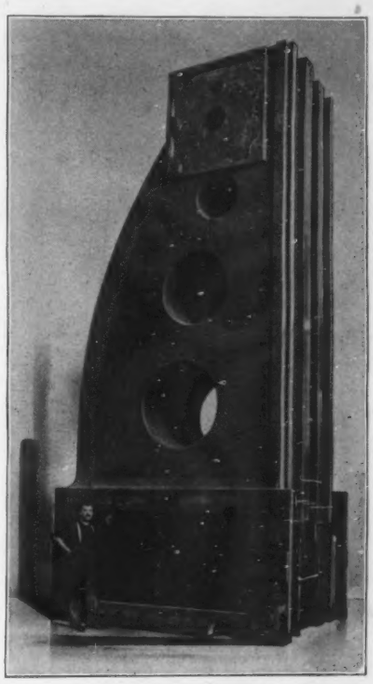


FIG. 5—HOUSINGS OF PLANER.

through a train of gearing. The drums of the pneumatic clutches are shown at 7 and 8, while 9 is the movable drum of the pneumatic clutch, which is brought into contact with discs in the portions 7 and 8 by air pressure on either side of it. The motor pinion drives the gear which acts as an idler between the motor and the gear 6 on the pneumatic clutch 7, which latter transmits motion to the planer table for the return stroke. The forward movement or cutting stroke is accomplished by means of the gear train composed of gears 1, 2, 3, 4 and 5, the latter being attached directly to the portion 8 of the pneumatic clutch. Gears 2 and 3 are change gears, which can be replaced with others to give a variable speed

to the table. The shaft of the pneumatic clutch is carried through the box 10 and on this shaft is the bevel pinion 11, meshing with the bevel gear 12, the latter being on the end of the main driving shaft of the planer. This shaft carries two gears which engage with the racks on the under side of the planer table and which are shown in Fig. 10 and also in position in Fig. 9. The other gears shown in the illustration, Fig. 6, operate the feed mechanism as will be explained later. The pneumatic clutches are thoroughly encased and are of the Niles-Bement-Pond type and comprise a large number of friction discs whereby a great friction area is obtained in a comparatively small space. These clutches are operated by compressed air. A small valve easily moved by hand controls the stopping, starting and reversal of the table and handles satisfactorily the output of the large driving motor. The handling of the amount of power required by a motor-driven machine of this size, would be impracticable with the employment of a belt drive. The drive is of all steel and the two bull pinions are forged directly on the shaft, being cut one-half pitch apart, in order to give smoothness of motion.

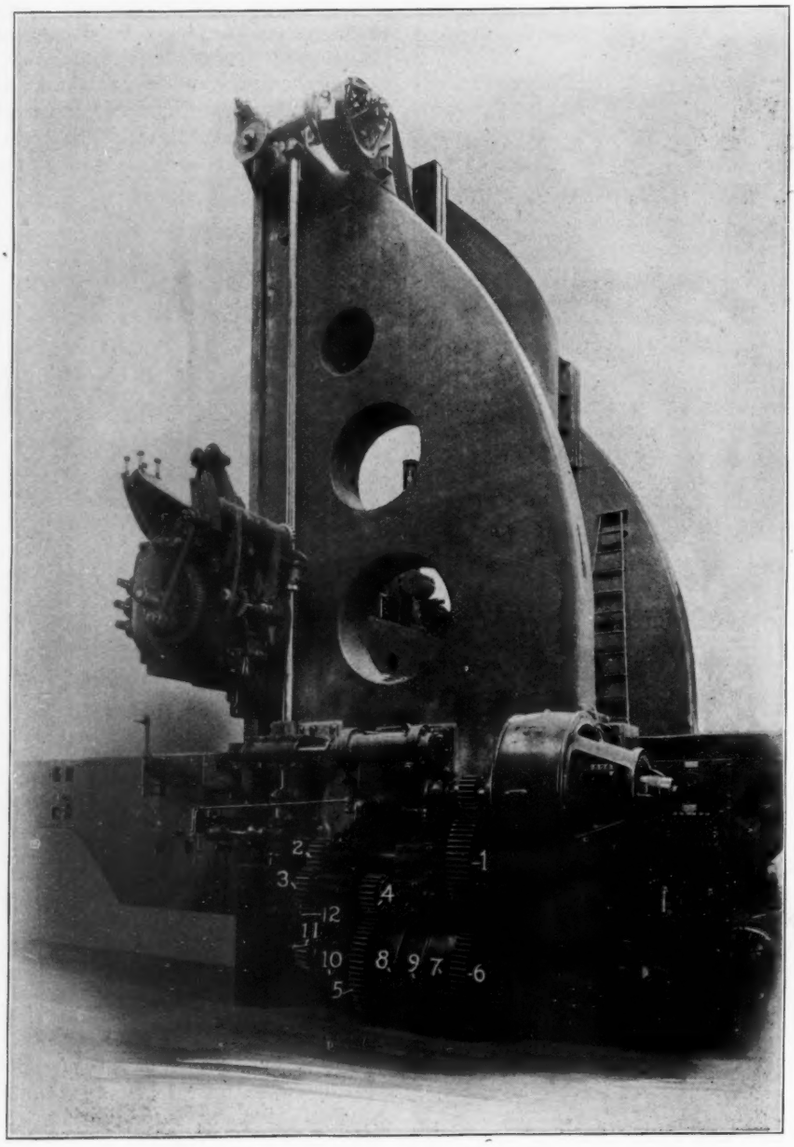


FIG. 6—PLANER DRIVE MECHANISM.

The slotter drive, shown in Fig. 7, is in its main feature essentially the same as the main planer drive, having, however, such modifications as to adapt it to its work. A 50-horsepower motor drives through a train of gears, the two halves of the pneumatic clutch, as shown, a bevel gear on the extremity of the clutch shaft meshing with a similar bevel gear on the square vertical shaft, which serves to operate the slotter ram. Directly above the motor is a disc, which determines the range of travel of the slotter ram. On the circumference of this disc will be noted two projections, which can be moved to any point on the circumference. The disc is rotated by means of a worm wheel, the worm being on the diagonal shaft driven by the bevel gear which meshes with another bevel gear on the square shaft of the slotter drive. As the disc is rotated, the projections strike a trip at the bottom, which may also be controlled by the hand lever shown, and throw the controlling valve of the pneumatic clutches, thus reversing the motion of the slotter ram.

By means of bevel and spur gears, motion is transmitted from the vertical square shaft of the slotter drive to a horizontal square shaft running along the top of the cross rail and clearly shown in Figs. 2 and 3. This shaft carries pinions engaging with large gears driving the rack through a pinion on the same shaft. The illustration, Fig. 12, shows the back of the cross rail and illustrates the gearing through which motion is transmitted from the vertical square shaft to the horizontal square shaft, together with the bearings for the horizontal shaft. Only the cover of the slotter gear drive can be seen, however. The pinion on the square shaft slides and can be thrown in or out of gear, as desired, so that either or both slotter rams can be used.

Referring again to Fig. 7, near the bottom of the square shaft is seen a bevel gear on the end of a horizontal shaft. This shaft goes across the bed and can be connected to the mechanism operating the valve of the feed cylinder on the opposite side of the planer. This feed mechanism is used for feeding the heads, and is clearly shown in the illustration, Fig. 6.

Referring to this illustration, there will be noticed on the left side of the housing just above the gearing a cylinder with a piston rod extending to the left. This rod carries a rack, which meshes into a gear near the bottom of the vertical feed shaft, which has on its lower end a bevel gear meshing with another bevel gear on a horizontal shaft transmitting motion to the vertical feed shaft on the opposite side of the planer. The movement of these feed shafts is constant at all times and variation in the amount and direction of the feeds is

obtained by adjusting the connecting rods and the slotted cranks at the ends of the cross rail. The valve for controlling the air to the air cylinder is thrown automatically at each end of the stroke. This movement is taken from either of the main driving gear trains to the table, or from the slotter gearing, by means of the horizontal shaft heretofore mentioned, when slotting is being done. To throw out the feed, it is only necessary to close a valve cutting off the air supply. The gears for accomplishing this motion are shown in the illustration, Fig. 6. On the short horizontal shaft located just above the figure 3, in Fig. 6, will be noticed two bevel gears placed back to back. The one facing the motor is driven from the main gear train and is used for controlling the feed motion when planing. The bevel gear adjoining this one may be thrown into mesh with the horizontal shaft from the slotter drive and thus controls the feed mechanism when slotting. These gears are joined together and can slide along their horizontal shaft. Therefore, when one is in mesh, the other is free, and there can be no interference between the slotter and the planer feed mechanisms.

The planer heads are so made that they cannot be swiveled when angular feeding is to be done. The slotted cranks, however, on the end of the cross rail are graduated in such a way that definite cross and vertical feeds can be obtained and by using at the same time the cranks on both sides an angular feed can be given to the tool, which is at times desirable.

In Fig. 6 the table feed, used when slotting or transverse planing is being done, has not been placed in position. It is shown, however, in the illustration, Fig. 1. Directly in front of and at the base of the housing is an air cylinder carrying a rack on the end of its piston rod, which meshes with a gear on the horizontal shaft seen projecting through the base below the cylinder. The shaft on which this gear is carried also carries a ram to which is fastened a pawl, which may be seen projecting just above the square block on the piston rod. This pawl can be set to engage the spur gear, the rim of which may be seen projecting just above the frame carrying the air cylinder. This gear may be connected to the main driving shaft 10 in Fig. 6. The variation in the stroke or amount of feed is obtained by an adjustable stop regulating the amount of movement in the air piston in the air cylinder. This adjustment is made by means of the right hand wheel shown in Fig. 1, the left hand wheel being used for connecting and disconnecting this feed to the main driving gearing of the planer.

In Figs. 1 and 6 can be seen a vertical shaft situated where the reversing hand lever of the smaller type of planer is usually found. This shaft has two sockets attached at the upper end, in one of which is placed a handle. The upper socket is connected to a shaft running down to the bottom crank, which controls the slotter. The connection of this lever to the slotter control can be followed clearly by means of Figs. 1 and 11, it going through the bed, as shown in Fig. 1, and coming out on the opposite side, as shown in Fig. 11, and thence by means of the curved connecting rod, running back of the housing and out through it to the slotter reversing mechanism at the reversing disc. The lower socket on the control handle governs the movement of the table when regular planing is being done. It is connected by means of a lever and rods of the reversing dogs on the bed at both sides. Only one handle is furnished for each side and thus mistakes arising from throwing the wrong lever are avoided.

The motor for the fast traversing of the heads is shown on the end of the cross rail in Fig. 6. Reversing is done through friction clutches and a safety is provided to prevent throwing in the fast traverse and the feed mechanism at the same time. The motor for raising and lowering the rail is situated on top of the housing and may be clearly seen in Figs. 1, 6 and 14. This motor is connected at all times to the elevating screws and is stopped, started and controlled electrically.

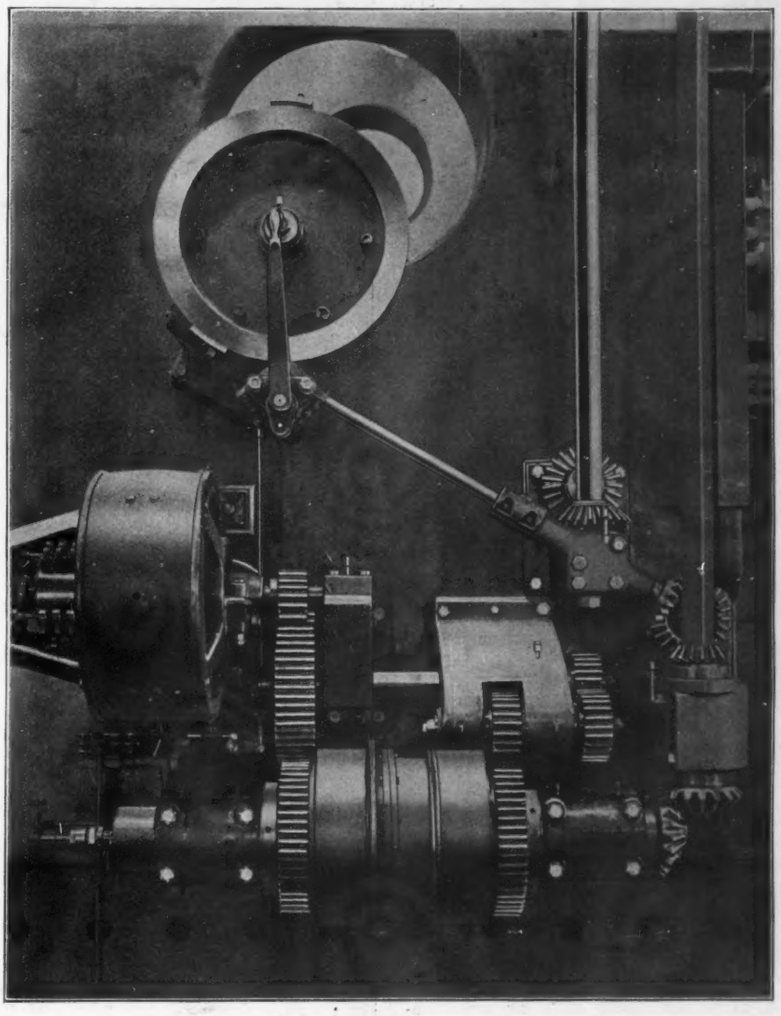


FIG. 7—SLOTTER DRIVE.

THE APPRENTICE SYSTEM OF THE NEW YORK CENTRAL LINES.[1]

By W. B. Russell.[2]

The necessity of an adequate recruiting system for the supply of trained mechanics is evident to all who are familiar with our present industrial conditions. The object of this paper is to present the details of a comprehensive, practical and workable apprentice system, which is already in successful operation, and which, because it is constructed upon carefully studied basic principles, can be made to work under all conditions and in any branch of manufacturing or repair work.

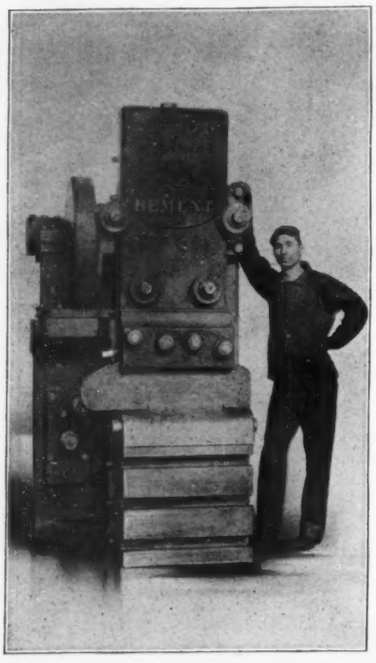


Fig. 8—One of the Planer Heads.

Efficient apprentice training is expected not alone to raise the grade of mechanics, and to provide from the ranks the necessary leaders and officers, but also to produce ultimately an organization in which men and officers alike can think intelligently, an organization replete with co-operation and efficiency; with its members bound together by association and by training, an organization fully equipped to meet the increased demands of progress and competition. Our large manufactories and railroads are suffering from a lack of knowledge of their men and the possibilities of these men. Large companies are too apt to go outside for their leading employes simply because they have no means of knowing whom they have in their midst capable of filling the important positions. It is not the mere training of workmen that is needed. We want also a system which automatically necessitates intimate knowledge of the capacity and possibilities of the material at hand. Nothing will reveal or cause ability and capacity to discover itself as will a well regulated apprentice system.

To train an apprentice and not to make use of him when out of his time is to lose the best results of the effort, and yet but few organizations at the present time are prepared to make intelligent use of graduate apprentices. The bright boy is blamed for leaving at or before the completion of his term, but the fault is largely due to the failure of his employer to appreciate his true value and to make further progress possible. It is not economy to spend three or four

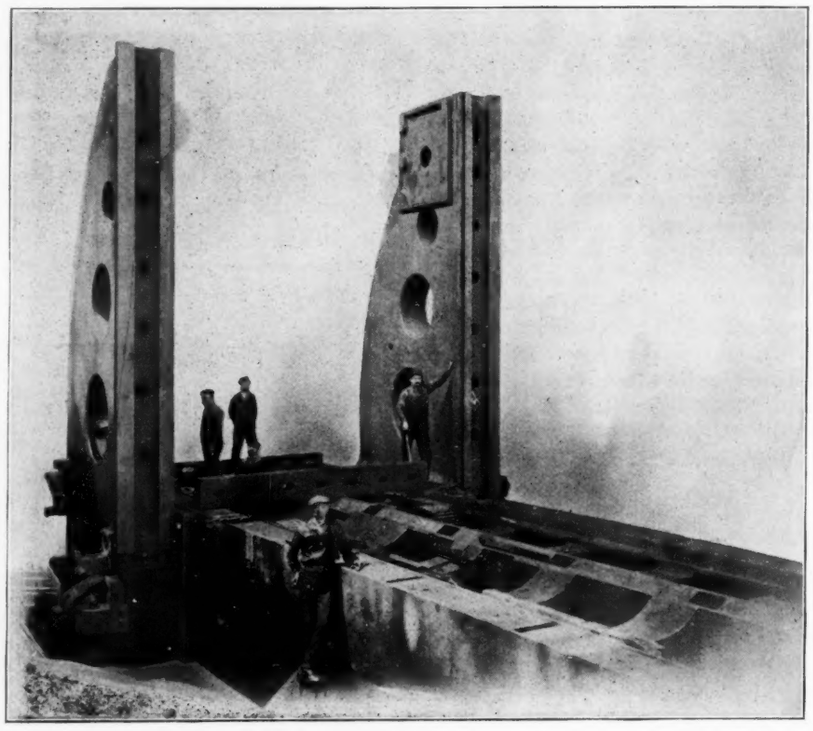


Fig. 9—Planer in Course of Erection Showing Position of Main Driving Gears.

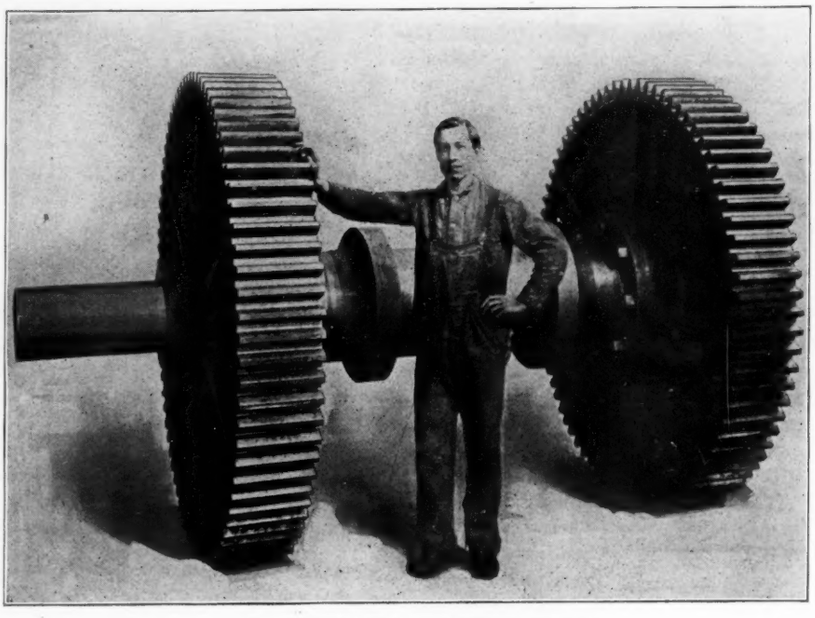


Fig. 10—Main Driving Gears.

[1]A paper presented at the New York (Dec., 1907) meeting of the American Society of Mechanical Engineers.
[2]Junior Member of the Society.

years perfecting a boy and then to let him go, and a continuance of such policy will ultimately kill the best apprentice system. Nothing less than a complete and radical change of policy is needed in most organizations to fit them both to attract and to hold apprentices.

The apprentice system is now organized on the New York Central Lines, was inaugurated on March 1, 1906, by J. F. Deems, general superintendent of motive power, although evening schools for apprentices had existed for a number of years at several of the shops. The system here described has the hearty approval of both men and management. It is a cold-blooded business proposition which has paid for itself from the start, and which has not a particle of philanthropy connected with it.

The general plan is two-fold and provides for shop instruction of the apprentice in the trade and for his instruction in educational subjects allied to his trade during working hours while under pay.

A shop instructor teaches the trade in the regular shop and on the regular work. As the majority of the apprentices at each shop are machinists, the shop instructor is preferably an up-to-date all-around machinist giving instruction in the machinist trade, but with sufficient knowledge of the other trades, which may have apprentices, to be able to supervise intelligently apprentices in those trades. If the shop is small he gives only a portion of his time, while in a large shop his entire time is taken and he may require assistants. He must possess the necessary tact and be invested with sufficient authority to command the respect, co-operation, good will and confidence of all concerned.

The educational classes are taught by a second instructor who may be either a draftsman, an advanced mechanic, or a mechanical engineer. His previous education is of less importance than his ability to explain simple shop problems, and his appointment should be based as much on the possibilities of his development as on his actual attainments. Previous experience in teaching is not necessary, although experience in teaching evening classes may prove helpful. The ideal instructor is a man who can look at problems from the standpoint of the apprentice, who can work them out with the apprentice, and who can bring himself to realize and appreciate the difficulties as they present themselves. This type of instructor may often be the man who is obliged to study nights to keep ahead of his class. The educational instructor should spend only a part of his time in teaching, and will be able to keep the educational work closer to company practice and himself in line of promotion in the organization if he at the same time retains a position in the shop or in the drafting room. Where the educational work is sufficient to require the full time of one man, an assistant should

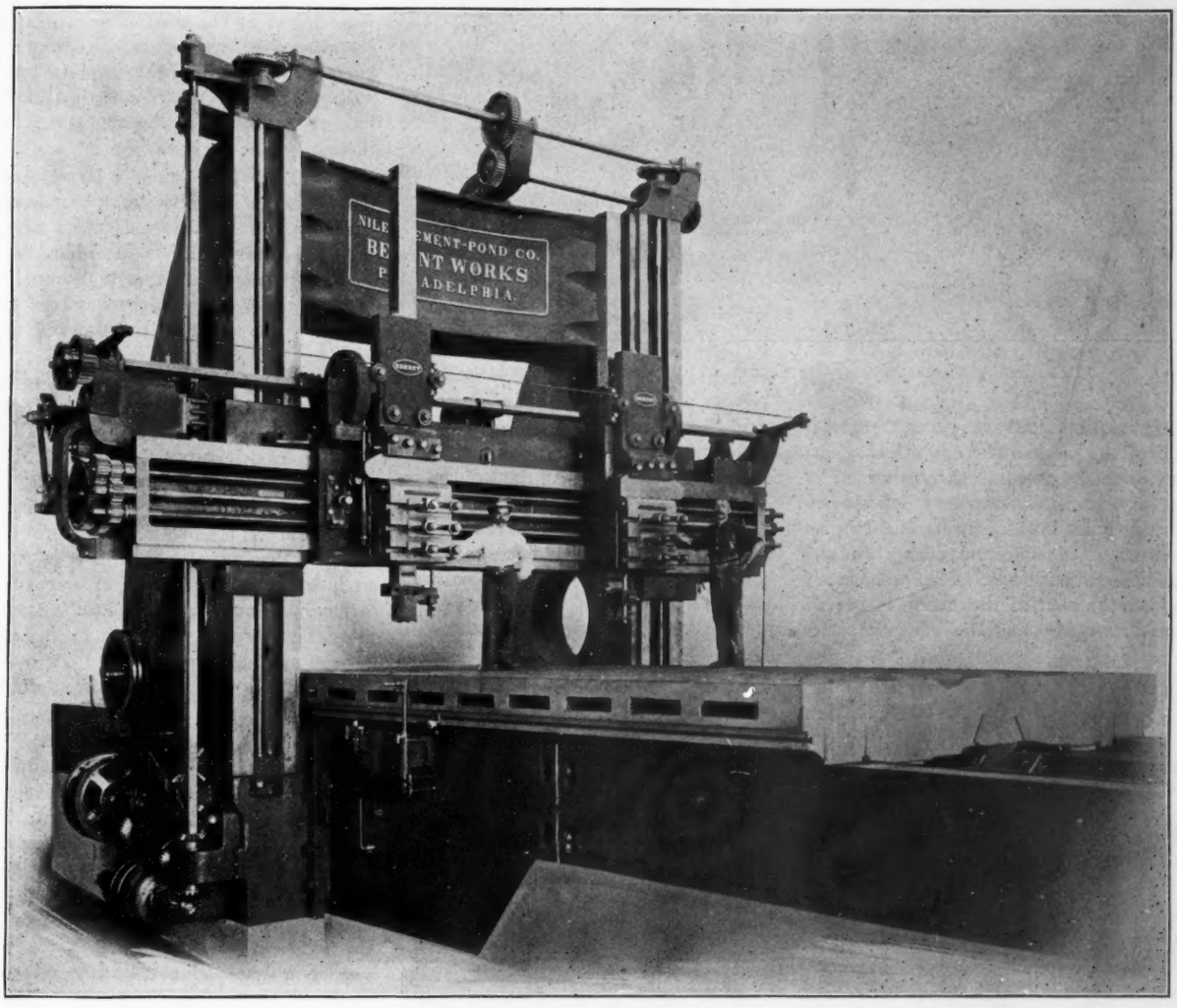


FIG. 11—GENERAL VIEW OF COMPLETE PLANER—SHOWS SLOTTER DRIVE, SLOTTER RAMS AND HEADS.

be provided and both should give part time to the work.

The fact that the shops of the New York Central Lines are widely separated necessitated the organization of a central department. C. W. Cross, who was well known throughout the New York Central system as master mechanic of a large division, was appointed as superintendent of apprentices to have general supervision of the work. The educational features were delegated to the author. The central organization was also desirable to procure uniformity of effort and to prevent waste of time and energy on unprofitable experiments. The problem of making the men of the future is one of such magnitude, and the questions arising on a large railroad system are so numerous that it is necessary to have one or two persons who shall give their entire time to this work.

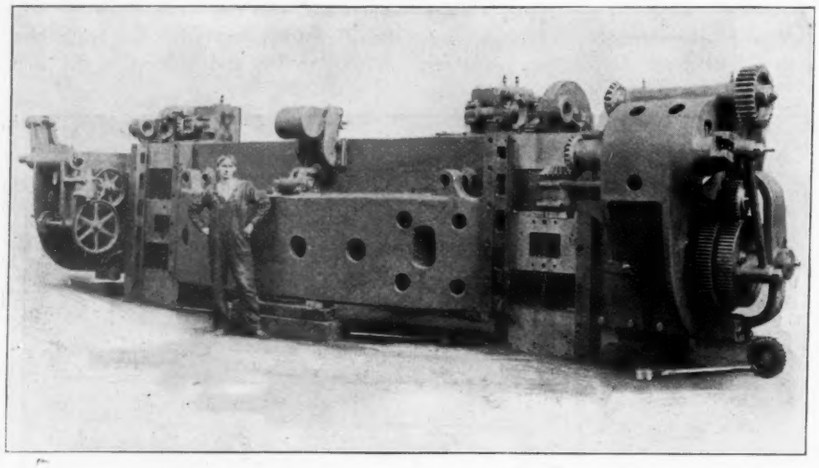


FIG. 12—BACK OF CROSS RAIL OF MACKINTOSH-HEMPHILL PLANER.

The plan is now in operation at the nine larger shops of the system and already includes about 500 apprentices. A uniform set of regulations has been adopted showing the classes of work in the shop and the time allotted to each class. These regulations have been made sufficiently flexible to suit the various conditions in different shops, to insure the prompt movement of all apprentices and yet to allow more rapid movement where special merit warrants. Uniform apprentice certificates are issued at the completion of the regular course which entitle the holder to preference in employment at all shops of the system.

All of the work done by the apprentices is a part of the shop output. The shop instructor is present to make each machine run at its best efficiency, even when handled by a "green" apprentice. The apprentices are still responsible to the foreman as formerly, but the foreman is relieved of the necessity of instructing them and is left free to run his department. The shop instructor passes on applicants for apprenticeship and in connection with the educational instructor recommends dismissal if unsatisfactory during the first six months. The shop instructor also arranges the changes of work in conference with the foreman. He keeps fully informed of the conditions existing in the various departments of the shop; he is in close touch with the foreman and gang bosses; he knows when and where the stress of work is heaviest, and in making suggestions and recommendations he takes these matters into account. His position in the shop is such that his judgment is accepted by the foreman, and his recommendations followed by the shop superintendent. His personality is such that he inspires the respect, and at the same time invites the confidences of the apprentice. From the nature of his work he is kept in touch with the latest shop practice and is in line of promotion in the shop organization.

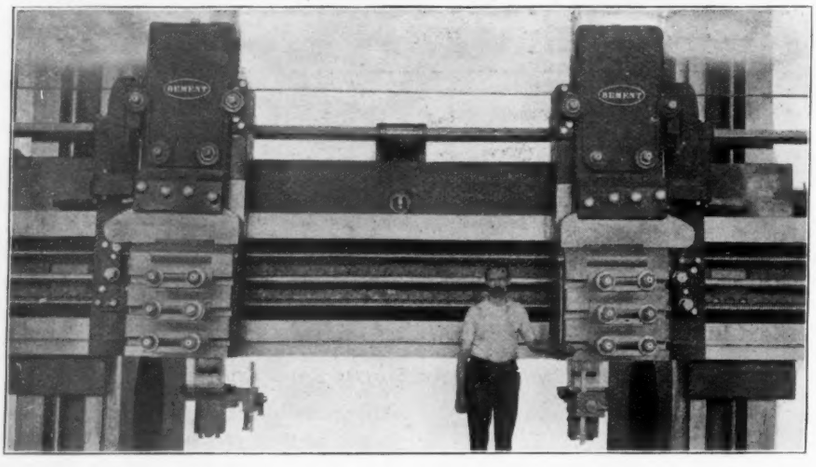


FIG. 13—FRONT OF CROSS RAIL OF MACKINTOSH-HEMPHILL PLANER.

Class room instruction is largely individual, as the same class may contain apprentices just starting and others nearly out of their time. Educational ideas have been reversed. Much that is dear to the mathematician and physicist has been discarded. The work is so arranged that each apprentice may go as rapidly or as slowly as his ability allows. All principles are handled through shop problems and must have practical bearing. Class work is closely adapted to shop conditions. The problems are worded in the language of the shop. The whole scheme of education is simple and more elementary than usual, although it is made to include many principles of mechanics, strength of materials and steam, usually taught in technical schools. In fact the course of study fits the conditions, and the conditions are not those imagined by most educators.

Text books cannot be used directly for apprentice instruction even if suitable books could be found, as the average apprentice has a strong aversion to books. The literature for such instruction is yet to be written. One or two books are now available for reference, but the bulk of this material must be in the form of separate sheets, given out one at a time and arranged to advance gradually.

The chief features of the educational work are mechanical drawing, which is made the back bone of the course, and shop problems which includes the other branches. The drawing is arranged to start directly on working drawings of actual machine and locomotive parts and yet to advance so gradually that even a dull boy can make headway. No time is taken for pure theory, and skill in drawing lines and making letters is obtained incidentally while making useful drawings. Blue print sketches are used to assist the instructor, but these are drawn so that they cannot be copied and each

sketch leaves more or less to be worked out by the apprentice.

Mathematical problems as met in a shop, or for that matter in every-day life, do not come classified with the rule at the top of the page. They are not even divided into arithmetic, algebra and geometry, and apprentices often meet problems so mixed in with facts, and so combined in the practical application of natural laws, that in many cases they do not appear to be mathematical problems at all. Shop problems taken indiscriminately from practice and put before apprentices would result in confusion and failure, but it is possible by careful selection and adaptation to get together problems clothed in every-day language, which are practical and useful and which, though actually classified and to some extent graded, do not show the classification. The terms algebra, arithmetic and mathematics are never used, and the sheets are not divided according to subjects. A running review is maintained by constantly introducing problems on the ground already covered.

Interest is further held by varying the standard of difficulty and mixing the easy and the hard problems as they are apt to come in practice. In getting together these problems, all departments of the railroads and many outside sources of information have been utilized. Company drawings, standards and records, facts and data from the technical press, suggestions from motive power officers, problems directly from the shop and drafting room, hints from instructors and points picked up in conversation with foremen and mechanics have alike been used. Experimental apparatus is being installed in the school room so that natural laws may be illustrated, but not necessarily proved, as it is the intelligent use of these laws, and not their proof which is desired. Models and actual machines are used for illustrations. In gearing, the gears are fitted on to a screw cutting lathe in the school room and revolved as a check to the method of figuring them. Locomotive valve setting is introduced by a thorough course in valve setting on a stationary engine located in the school room and arranged to run by compressed air. Lectures are not well suited for apprentice instruction and when used must be short and must take the form of talks or recitations.

Classes are held from 7 to 9 o'clock in the morning, each apprentice reporting for two mornings a week. The apprentices ring in at the shop and then come to class rooms located on the shop property, where they are under shop discipline. At 9 o'clock they report again in the shop. Compulsory evening classes for apprentices have never been entirely satisfactory, but the plan of holding classes during working hours has been used by the British Admiralty for 60 years with entire success. Home work is expected on the problems.

An elaborate system of reports from both instructors is made to the local shop officers who forward them to the superintendent of apprentices. These reports show first, the ability at the trade, second, the dispositon and personality of the apprentice, and third, the standing in class work. The instructors are at all times required to know the standing of each apprentice, thus making examinations unnecessary. Special emphasis is placed on the personal touch maintained between the instructor and the apprentice with a view to determining the type of work or branch of service for which the boy is best suited.

This movement differs from most efforts to better industrial conditions, in that it starts at the bottom in marked contrast with the common practice of providing special advantages for the especially bright. The rank and file are not touched by special apprenticeship or special courses at high schools. Industrial education must start lower down the scale, and the genius will be the first to profit by the advantages offered. The problems designed for a boiler-maker apprentice have been found quite useful with college graduates and the problems used for apprentice classes have been used with equal success in evening classes for foremen, mechanics and inspectors. Experience has proved the desirability of keeping boys in direct contact with the shops from the very outset, in which point the plan differs from that of M. W. Alexander, of the General Electric Co.

The immediate and direct results of the apprentice system have been, increased output, (nothwithstanding the four hours per week spent in class) less spoiled work, ability to read drawings, to lay out templates and to make sketches, a better grade of apprentices, increased interest in the work, suggestions of apprentices as to improved methods and tools, draftsmen for company drafting rooms and apprentices fitted for special work as needed. Local officials have everywhere been quick to note the benefits of apprentice training, and are unanimously enthusiastic and interested. One immediate result of the opening of the apprentice schools was the request from foremen and mechanics for educational classes of a similar nature, which resulted in the organization of self-supporting evening classes at seven of the shops taught by the apprentice instructors, using practically the same courses of study as provided for apprentices.

The essential points in the inauguration of an apprentice plan like that described may be stated as follows:

a The full endorsement and the support of the management from the president down, and the hearty co-operation of all concerned. Without this the movement is sure to fail.

b The necessity of preparing a shop organization to make use of the apprentices who are thus trained, so that bright young men will be attracted to start on an apprenticeship which will graduate them into an organization where ability will be recognized, and where advancement will be possible.

c The selection of a shop instructor, possessed of the necessary skill and tact who shall give a portion or the whole of his time, according to the size of the shop.

d The selection of an educational instructor who shall have sufficient originality to cut away from current educational practice and to meet the local needs of the apprentice in his own way.

e The outlining of a course of study which will closely combine the theoretical and practical, and which will be framed for the dullest apprentice and not for the high school graduate.

f A recognition of the fact that the best results can be obtained only when the instruction is on the shop property and under shop control and that technical schools, trade schools, correspondence schools, high schools, Y. M. C. A., or other outside agencies, cannot satisfactorily meet the needs of the rank and file of apprentices.

g The use of a room for drawing and class work near the center of the shop property.

h A realization that the plan can be installed in most shops with talent already employed.

i A recognition of the fact that instruction must be given during shop hours and that evening classes for apprentices are unsatisfactory.

j Industrial organizations are composed of men, not machines, and in the long run, no organization or department can prove really efficient which does not make allowance for the full development of its men and which does not count on the value of the personal touch in developing a proper loyalty and efficiency.

k The shop management must be prepared to provide evening classes self-supporting, or nearly so, on account of the fees charged, for the present foremen and mechanics who are sure to ask for an opportunity to obtain educational training similar to that of the apprentices.

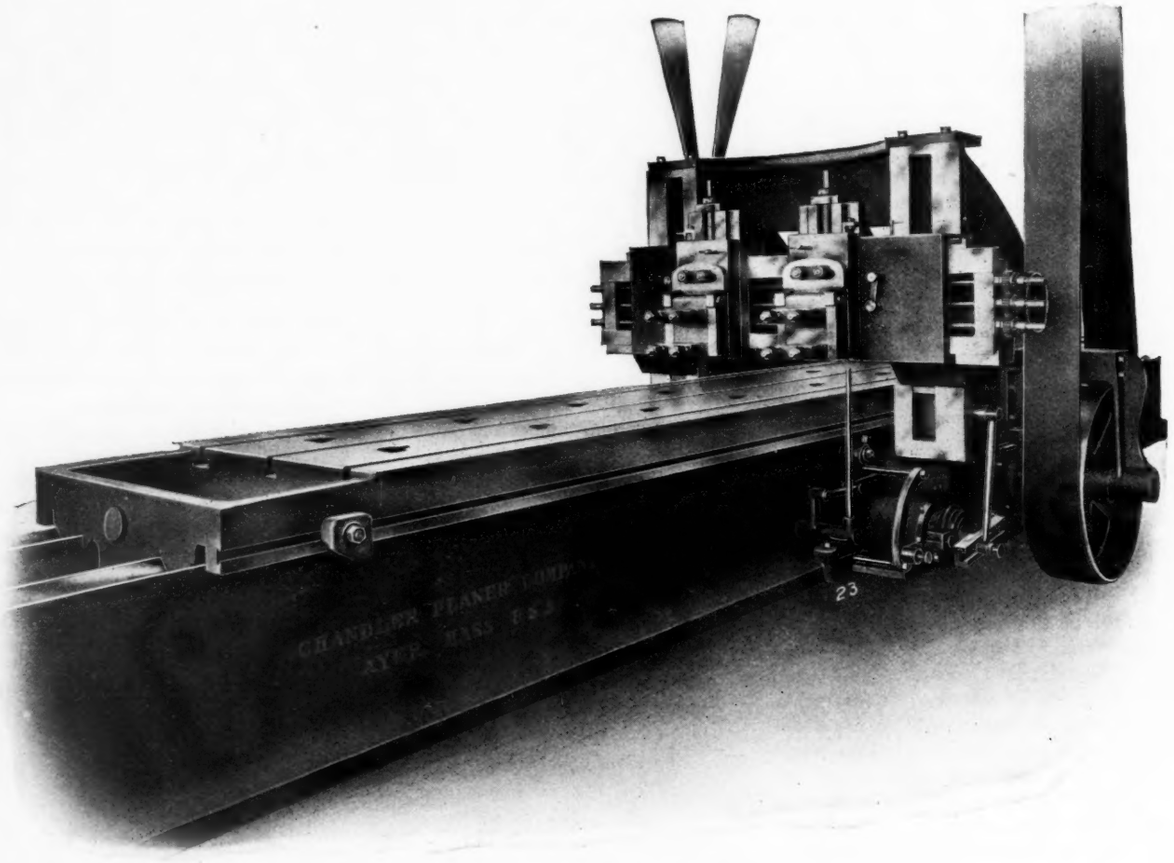
No previous reference has been made

to the most important principle underlying apprentice training. In addition to teaching the apprentice a trade and teaching him to think, it is vitally necessary to aid in the development of his moral character and in his loyalty to the right. These objects do not, from their nature, permit of immediate demonstration of success. They are, however, vastly important and the character side of the problem is, in the long run, the larger side. It would require an entire paper for its full treatment. No apprentice plan can possibly succeed if this part of the problem is not uppermost in the minds of those in charge. Neither the employer nor the community has anything to fear from the right-minded, conscientious man who thinks. Much may be feared from one who is not conscientious and right-minded or one who permits others to do his thinking. The author believes that the value to the employer, the community and the country of the influence of intimate association between apprentice boys and big-minded, "broad gage" instructors cannot possibly be over estimated. In comparison with this influence mere details of the apprentice plan are absolutely insignficant.

CHANDLER CLUTCH PLANER

Owing to the fact that the return stroke of planers had been speeded up to the capacity of shifting belts to overcome the momentum, the ordinary belt shifting planer had reached the limit of its mechanical efficiency before the advent of high speed steels. The planer was, therefore, the one machine tool, the speed of which was not limited simply by the cutting capacity of carbon steels. Its speed limit was as much in the momentum as in the cutting.

To a belt shifting planer there are two obvious limitations; the width of belts that can be economically shifted, and the speed at which pulleys and bearings can be safely run. The Chandler Planer Co. made radical, practical, advances in belt shifting planers. The result was accomplished by the use of a speeding up auxiliary or second return belt, which came into action after the reversing or ordinary return belt had started the mechanism of the return stroke. The



CHANDLER CLUTCH PLANER.

It is interesting further to note to what extent planer builders and planer users were misled by momentum. There was a generally prevailing opinion that the troublesome momentum was in the platen, and that the difficulty was not in starting, but in checking. Consequently, at the outset, there were unsuccessful attempts to increase planer speeds, by means of springs, buffers, floating racks, and other devices designed to check the speed of the platen. It is now everywhere recognized that the momentum to be dealt with is in the rapidly running pulleys and gears, and that the momentum of the platen is too unimportant to be seriously considered.

cutting speed was put at the full capacity of high speed tool steel, without reference to the return stroke. From the cutting speed the best practical reverse was made in the usual manner. As soon as the mechanism was under way on the return stroke, the reversing belt went off and was succeeded by another belt of higher velocity. At the end of the return stroke, the action of the belts was reversed, that is to say, the fast belt went off and was followed by the slow or reversing belt, which retarded the mechanism just preceding the reversal to the cutting stroke.

The most obvious reversing mechanism for a non-shifting belt planer is some

form of a clutch. It is probable that every planer builder has had clutch planers in mind, and most of them have experimented along that line. The problems that a clutch planer encounters are so numerous and severe that all previous experience with clutches is of little avail Instead of an occasional setting and releasing, a planer clutch is often called upon to operate as often as once every second.

The first and most obvious form of clutch is one that is set and released by the direct action of the platen or by the operator. Such a clutch is liable either to set so suddenly that the shock will break the mechanism, or so slowly that the slipping will heat, wear and grind the bearing surfaces, or, as often happened, it fails to set at all, especially at the end of an extra heavy cut.

These objections demonstrated the necessity of some independently acting medium between the lever and the dogs on one hand, and the clutch mechanism on the other. For a while the most available medium seemed to be compressed air. Consequently, there came an era of pneumatic clutches which were an advance in that the operator or platen dogs simply tripped the valves and the air did the rest.

Pneumatic clutches have, however, proved objectionable in that they introduce a complication, in the shape of air valves, with which the ordinary planer operator is unfamiliar. The complication was further increased by the necessity of a reducing valve to secure more practical conditions under varying length of strokes. Furthermore, the use of pneumatic clutches is limited to shops already having air compressor plants, otherwise it is necessary to install an independent air plant to operate the planer, and that makes the cost practically prohibitive. Furthermore, it was found that compressed air could not always be depended upon to overcome the objections that had already been encountered in directly operated clutches. At times a pneumatic clutch closes so suddenly as to break the mechanism, and sometimes through leakage operates at the wrong time.

At the shop of the Chandler Planer Co., Ayer, Mass., a clutch driven planer, cut of which is shown herewith, is in operation. The clutches of this planer are constructed on novel principles, with a view to overcoming the defects herein stated. This planer is being subjected to severe and protracted tests, in the presence of critical and practical experts, and is demonstrating high efficiency under all conditions.

It removes the side of the head, up to the web, on a pair of extra hard 70-pound relay switch points, cutting back 9 feet in less than six minutes, which time it is expected will be reduced at least 30 per cent. At a cutting speed of 20 feet it removed from a 40-point carbon steel forging, a chip ¾ inch deep with ¾-inch feed. It runs for hours on a 14-inch stroke, without giving the slightest indication of injurious heating or wearing. It reverses as smoothly as the best belt shifting planer.

The planer is 42 inches by 20 inches by 20 feet and weighs about 30 tons. It is particularly massive throughout. In order to test the clutches on the severest class of work, the planer is of the frog and switch type. Its cutting speed is 20 feet with a return of 4 : 1. The cutting belt is 10-inch double and runs at a speed of 1860 feet per minute with ratio of 93 feet of belt to one foot of platen. The reversing belt is five inches wide and runs at a speed of 3,900 feet per minute. The dimensions of most of the tools used in the tests were 2½ x 3 inches and were of various makes of high speed steels.

The clutches, which are two in number, of the multiple disk order, are located inside the bed of the planer on the second shaft, and are set by mechanism operated by the planer. All the dog or the operator can do is to trip the mechanism.

The advantages claimed for the clutches are that they provide a maximum bearing surface with a fixed minimum slip, avoidance of metal contact, a positive rather than a friction locking, elimination of shock, reduction of momentum, locking proportionate to the load, and impossibility of slipping when once set.

These results are secured in the following manner:

(1) The heating problem, which, perhaps, of all others, is the most to be feared, is overcome by sufficiently large bearing surfaces, made up of multiple disks; alternate disks being keyed to the shaft and shell of the clutch, and all moving laterally. When the clutch is closed the disks are pressed together.

(2) The amount of slip before locking, is accurately determined by a timing mechanism between a primary clutch and the main clutch.

(3) The two clutches operate on the principle of differentials. The amount of locking of the main clutch is, therefore, determined by the difference in movement of the two clutches. It is obvious that any slip of either clutch increases the grip of the main clutch, and insures a locking in proportion to the load. In a sense, the main clutches are positive rather than friction.

(4) The shell of the main clutch is a case within which the disks run in a bath of oil. The oil not only lubricates and reduces the chance of heating, but serves as a cushion which gives the clutches a soft, smooth, engagement. Examination of the disks, after severe and protracted tests, indicate that a film of oil is always interposed between their faces. It is obvious that so long as the disks do not come into metal contact, there can be no wearing and no heating.

(5) The clutches are two in number, one engages with the cutting belt shaft and one with the reversing belt shaft. Consequently, one clutch is idle while the other is in operation. This gives the idle clutch a chance to rest and become thoroughly lubricated before engaging.

(6) The clutches are self-contained. When engaged, both the primary and main clutch revolve as one.

(7) As momentum is the product of weight multiplied by velocity, every material reduction of either, greatly reduces the difficulty of reversing. In this planer the clutches are on the second shaft, and the only parts of the clutch that reverse are the disks that are keyed onto the shaft. The clutch case and all the other operating mechanism moves constantly in one direction.

(8) Supplementing the primary and main clutches is a mechanically operated device which insures a proper and positive engagement of the primary clutch and leaves nothing to the mischance of dogging, and provides a proper margin of safety to meet all the conditions of varying platen load.

(9) The clutches are located inside the bed of the planer, and, therefore, add nothing to its size, and do not, in any way, change its general appearance.

(10) To run the planer light at a cutting speed of 20 feet with a return speed of 4 : 1, requires 6 to 7 horsepower on either stroke. The reverse requires about 20 horsepower. On severe cutting loads the clutches have demonstrated ability to hold without slipping under a load of over 50 horsepower.

Before their present clutch planer, which was used for the tests mentioned herein, was installed, one of their standard 36-inch planers with the new clutch was used. This they tested on severe work for about six months, with a view to determine the efficiency of the clutch, and wherein it could be improved by reconstruction. The Chandler Planer Co. was incorporated January, 1905. The westerly half of their shop was built that year and the easterly half the following spring. The shop is 76 x 256 feet, exclusive of the power plant and forge shop. Its full quota of men is about 150. The Chandler planer was first brought out in 1904. So far it has marketed the following sizes: 24-inch, 30-inch—two styles, and 36-inch, three styles. The clutch planer is its first 42-inch tool and it is building its first 48-inch.

AN AUTOMATIC ELECTRIC BLAST FURNACE SKIP HOIST

A new type of blast furnace skip hoist, electrically driven and entirely automatic in its operations, has been designed by the Lidgerwood Mfg. Co., 96 Liberty street, New York, and the original installation, which has been in service sufficiently long to demonstrate its complete success, is shown in the accompanying illustrations. This hoist is constructed along remarkably sturdy lines, weighing in all about 51 tons, and includes a number of other features designed to meet the peculiar requirements of the large blast furnace, among these being the furnishing of absolutely uniform service regardless of the load and provision for the almost instantaneous repair of any part.

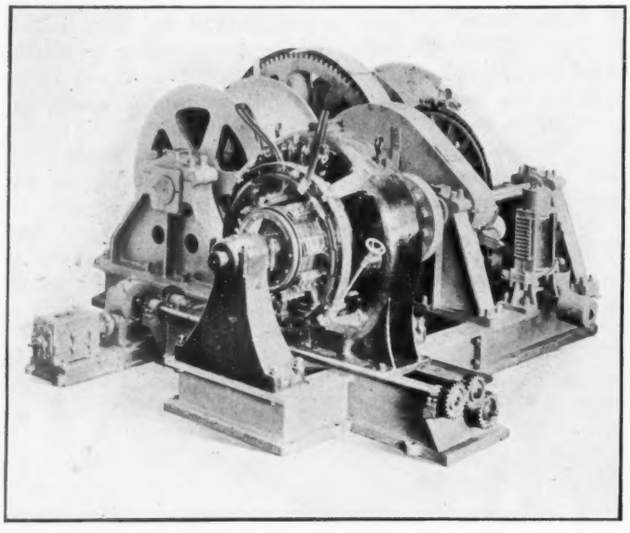


FIG. 1—AUTOMATIC ELECTRIC BLAST FURNACE SKIP HOIST—MOTOR SIDE.

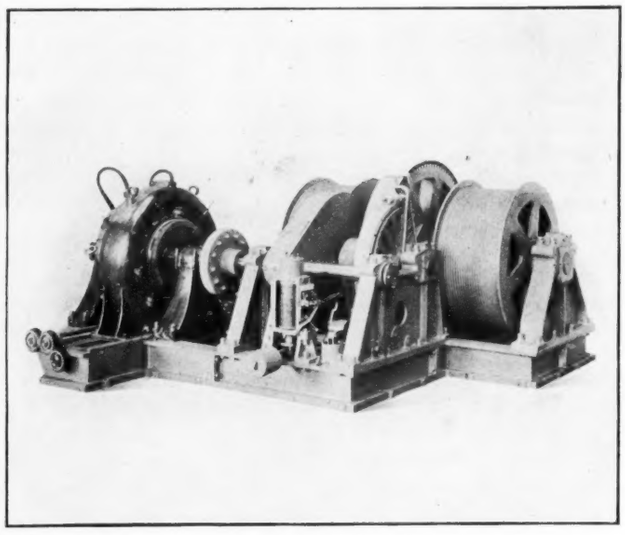


FIG. 2—AUTOMATIC ELECTRIC BLAST FURNACE SKIP HOIST—DRUM SIDE.

The double drum type of hoist is employed, with four bearings supporting the drum shaft and the main driving gear being placed between the two center bearings. This gear is made in halves to the drum shaft, which is 15 inches diameter at the center and 11 inches in the drums. Steel gears only are used. An oil tight gear case encloses the motor gears and a wrought iron guard band covers the drum gears. Mounted on the intermediate shaft is the solenoid brake wheel. This brake is of the "V" type, of special toggle construction, has a travel of 3½ inches and is operated by a 550-pound solenoid of special construction and winding. Dash pots are provided to eliminate any shocks due to the falling of the brake weight.

The duty of this hoist is 24,000 pounds at a speed of 225 feet per minute. It is driven by a 175-horsepower motor, direct current, 300 revolutions per minute, 220 volts, compound wound. In keeping with the general heavy construction of the hoist, this motor is of especially heavy design suited for skip hoist service, and is built by the Crocker-Wheeler Co., Ampere, N. J. The armature shaft has the standard extension and is coupled to the hoist by a Baehr flexible coupling.

An innovation of importance, in view of the unbroken service demanded of the skip hoist, is the provision for the speedy removal or repair of the armature or field coils. With this idea, the motor frame is split vertically, with two bolts at top and bottom, and the brush rigging is so arranged that half is attached to each side of the motor frame and is free to move back and forth with the frame. In case it becomes necessary to remove the armature or repair the field coils, recourse can be had to an ingenious arrangement by which the frame can be instantly separated. This consists of two large square threaded screws run under the base of the motor, one on each side, through brass nuts attached to the motor base. These screws are made to revolve by a 6-horsepower, series-wound motor through a worm and wheel, so that all that is necessary to separate the frame is to remove the four bolts and bring the motor into use, the time necessary for performing this operation being as low as 16 seconds. Provision for further time-saving in changing the armature is made by arranging a channel-iron trackway directly over the hoist motor. This trackway carries two trolleys with chain blocks, one suspending an extra armature and the other being ready for the removal of the old. The operation of replacing an armature can be completed in a half hour.

The hoist is so constructed that, regardless of the load, the speed of the bucket at the slow-down is exactly the same in every case. In fact, a test of 25 trips with varying loads showed that the bucket stopped within ⅝ of an inch of the same spot each time. This is accomplished by a slow-down device, electrically controlled and operated mechanically by connection with the main shaft of the motor.

The hoist is mounted on a continuous cast iron bed plate, made in sections and bolted together. It is set on a solid concrete foundation and bolted down with 32 1¼-inch foundation bolts. No internal gears are employed and there is accordingly no overhung pinion, and another feature is the complete absence of tap or stud bolts, fitted through bolts with double hexagon nuts being used exclusively. The installation was made through the Pittsburg office of the Lidgerwood company.

Specifications of this hoist may be enumerated as follows:

Weight, complete	51 tons
Duty, at 225 feet per minute	24,000 pounds
Diameter twin drums	66 inches
Face twin drums	30 inches
Grooved for rope	1⅛ inch
Main gear wheel diameter	88 inches
Face gear wheel	12 inches
Teeth, 100; pitch	2¾ inches
Secondary gear wheel diameter	60 inches
Teeth, 89; pitch	1½ inches
Face of same	9 inches

GREATEST YEAR IN THE ORE RANGES' HISTORY

Splendid Record at the Mines and on Railroads and Lakes — Many Notable Feats Accomplished — Dull Season This Year Would Have Its Compensations

By Oliver J. Abell.

The year from Jan. 1, 1907, to the present time has been a season of wonderful performances in mining iron ore from the Lake Superior district, the most remarkable period in the history of a district notable for its unparalleled rapidity of development and tremendous achievements. The mere movement by lake of 41,288,755 tons of ore which was the season shipment, is a feat to command admiration, but when in addition the countless problems which enter into the mining and accounting work necessary are pointed out, the magnitude of the accomplishment admits of no comparison. It is to be remembered also that a strike in midsummer reduced shipments to the extent of 2,500,000 tons, that the same labor trouble handicapped the mines of Minnesota through almost the entire length of the season and that at the end of the year, in keeping with other curtailment of output, the shipments were reduced from what they could have been by at least 500,000 tons. To fairly estimate the capacity of the men and methods employed on the northern ore ranges, one may therefore place 45,000,000 tons as a season's output by no means impossible of attainment.

Midwinter Preparations.

Many noteworthy occurrences stand out in a review of the year. They began with the midwinter preparations on all of the ranges for a big season and particularly on the Mesabi range plans were begun on a tremendous scale, later to develop into record breaking performances. Winter stripping work in the frozen ground with temperatures averaging near 25 degrees below zero was carried on to an extent previously considered impossible. The shipping season opened up late and a month of it passed before production records began to approach those of 1906 and in fact much longer than that was required to overcome the handicap at some of the ports. It was early apparent, however, that a new mark was to be set this year and rapid gains were made, though almost entirely on the Mesabi range. In July, just when new monthly records of more than 6,000,000 tons began to be established, the second setback came in the form of a strike of the dock laborers at Duluth, Superior and Two Harbors, followed almost immediately by a strike among the Mesabi range miners. The trouble at the docks tied up shipping completely until Aug. 1, compelling an almost complete stoppage of the three range railroads. The men returned to work at that time, but the effect on the railroads and navigation was not dissipated for at least another month. The strike at the mines failed ignominiously, but dragged along in exasperating fashion for two or three months, decreasing both the number and efficiency of laborers very largely. Otherwise the months of navigation were occupied with one continual hustle until at the end of October the slackening of the pace began with the sudden decision to ship only that ore which was actually bought instead of storing on Lake Erie docks as in 1906 all that could be brought down.

The Season's Shipments.

The lake shipments from the Gogebic, Marquette and Menominee ranges amounted to 12,213,486 tons or an increase of 183,291 tons over last year. This will bring the total shipment by lake and rail to nearly 13,000,000 tons. The increase was due in large measure to the extra pressure on these ranges during the strike in Minnesota and a greater showing was prevented only by the December curtailment. It is a matter of note that stock piles were cleaned up to a greater extent than in a decade preceding. The Mesabi and Vermillion ranges sent down the tremendous total of 29,075,269 tons, an increase over 1906 of 3,591,869 tons. The total season shipment by lake and rail, therefore, will amount to more than 42,000,000 tons as compared with 38,522,239 tons a year ago. Of this total the Steel Corporation shipped 22,600,000 tons or 53.8 per cent, which is 1.8 per cent more than 1906.

Important Developments.

The season witnessed important progress in the development of the Cuyuna range, the extreme western end of the Mesabi, around and west of Grand Rapids, the Swanzy district of the Marquette range, the Iron River district of the Menominee and also the Canadian deposits near Port Arthur, Moose Mountain and Sudbury. The character of the ores in these various localities was fairly well known before and there were no discoveries that would result in raising the present average analysis of the ore.

Decreasing Iron Content.

Much has been written during the year regarding the decreasing iron content of ores and the growing scarcity of ores of Bessemer quality. Reference to such articles will afford more detailed evidence of actual facts than can be given here. It is true that a comparison of the analyses of ore from perhaps the majority of mines operating 10 years ago with the analysis of those same ores today would show a marked decrease in the iron content, maybe as much as 4 or 5 per cent in some cases, but even this is only a fraction of a per cent a year. The tendency is undeniable but not nearly so rapid as complaints from some quarters would lead one to suppose. When one is looking at mines that have been worked for 10 or 15 years, it is to be remembered that with those analyses must be averaged the newer deposits not discovered or developed at that time. Does the Hull-Rust opened up in 1905 with ore running from 60 to 65 per cent and a deposit of 100,000,000 tons look very bad? Or does the fact that the ore coming from the present Mahoning or Stevenson pits, may be a little bit leaner than when that pit was first opened detract from the significance of the millions of tons of ore in the adjoining forties that have never been touched and are in every way similar to the contents of the present pit? Millions of tons of ore in the heart of the Mesabi district and of as high grade as mines now operating lie undeveloped for a variety of reasons. Fully 75 per cent of the Mesabi ore shipped this year was of Bessemer grade. With mining operations proceeding at a less rapid rate, analysis guarantees can be more strictly adhered to.

The logic of lowering the iron content guarantee of ores is conceded, the fact that in the older mines the mining captains are skirmishing a little more vigorously to keep up the grade is admitted and the fact that more ore is required to make a ton of pig iron now than formerly, cannot be denied, but it still remains that there is exactly the same and no more necessity for alarm in regard to analysis of ore than there is in the matter of exhaustion of supply.

The Taxation Problem.

The question of taxing mining properties proved a vexatious problem, especially in Minnesota. There the rapid growth and tremendous proportions of the ore traffic apparently inspired the laymen legislators and tax commissioners with strange ideas, and, being unacquainted with the situation, they saw only swollen fortunes and vast revenues gained at the expense of the commonwealth. An attempt was made to investigate by a state committee, but it was of necessity a superficial inquiry and as a result both the total valuation—an excessive figure approaching $191,000,000—and the scheme devised for basing valuations are wholly unadapted to the commercial conditions of operating the mines. Accurate estimates were furnished to the state by mine operators regarding the amount of ore in their properties, costs and shipments, but despite a strenuous protest the report of the investigating committee was accepted by the state board of equalization. The chief injustice of the plan for taxing is that it places upon the comparatively small and variable annual output the burden of assessment from the vast untouched deposits and establishes for those deposits a per ton value beforehand, for years to come, basing that value on the highest prices known and without regard to future changes.

Some interesting figures were brought out by this investigation and it is now understood that the Minnesota deposits of ore approximate 1,170,000,000 tons, that the Steel Corporation's holdings amount to about 900,000,000 tons of this, of which nearly 200,000,000 were acquired by the Great Northern lease. In the Lake Superior district, the ore tonnage including undeveloped lands amounts to at least 2,000,000,000 tons. It was given out that in 1906 the Steel Corporation averaged on Bessemer sales $3.50 per ton and on non-Bessemer $3 per ton, allowing an average profit of from 30 to 75 cents. The average cost of marketing the ore was published as follows:

Cost of mining, outside of royalties	$0.70
Royalty average	0.26
Rail freight	0.80
Lake freight	0.75
Marine insurance	0.01
Depreciation on plant and mine	0.20
Taxes	0.05
Interest	0.02
Total cost at Cleveland docks	$2.79

In the items of mining cost and royalties, the estimate is probably lower than the average for independently owned properties and for mining elsewhere than on the Mesabi the average cost given is from 30 to 50 cents too low. In 1907, from 30 to 35 cents would probably be nearer the average for royalties and an estimate of the average marketing cost at Lake Erie ports for the year would be $3.10, which would leave a margin of $1 per ton on the nominal price of Mesabi non-Bessemer ore. Nominal prices for the year at Lake Erie are well known as follows: Old Range Bessemer, $5; Mesabi Bessemer, $4.75; Old Range non-Bessemer, $4.25, and Mesabi non-Bessemer, $4. This would give a nominal average price of about $4.50, which price, however, because of the existence of long term contracts made at lower prices, is probbly 50 cents more than the average price actually obtained.

Lake Navigation.

In the department of lake navigation, the year saw many advances. Construction of the first steel ore dock on the Great Lakes was begun at Two Harbors. Docks at Superior, Two Harbors, Ashland and Escanaba were rebuilt. New channels were opened in St. Louis river at Duluth, in the St. Mary's river and at Detroit. The 605-foot boat made its initial plunge and in all a carrying capacity of 363,500 gross tons and 41 new boats were added to the fleet of ore vessels. A new Lake Superior record was established by the Wm. B. Kerr in taking 12,243 tons of ore from Duluth. The freight rates remained as in the preceding year, head of the lakes to Ohio ports, 75 cents, Marquette to Ohio ports, 70 cents and Escanaba to Ohio ports, 60 cents. Accidents, despite the increased number of boats, were not above the average in number though several serious collisions occurred in the rivers. The most spectacular disaster was the sinking of the new steamer Cyprus in a storm on Lake Superior downbound with her second cargo of ore. Receiving ports were equipped with increased and improved unloading facilities, but even with this added capacity at lower lake ports it was noticeable that the loading end is still capable of handling more material than the unloading

Mine Accidents.

In the matter of mine accidents, the year was a normal one with two exceptions. For the most part, the iron ranges are not visited by disastrous accidents such as are more or less frequent in coal mining regions, but the fire at the Sparta mine on the Mesabi range, where three men were caught and lost their lives, and the dropping of the cage at the Rolling Mill property on the Marquette range, which killed 10 men, were the worst the iron country has known for many years. The latter was particularly deplorable, as no satisfactory explanation or cause of the accident was ever developed even after a most careful and rigid investigation.

Mesabi Range.

It was expected that nearly all the gains for the year would come from the Mesabi range and so it proved. A total of 27,390,375 tons, or 3,500,000 tons more than a year ago, was shipped out of this narrow stretch of country containing perhaps 150 square miles. Again Hibbing was the principal producing district, yielding 15,000,000 tons. More than the fact of its gain over 1906, however, is the fact that in 1907 the record of the Iron Mountain mine was broken by a mine of this district, the Hull-Rust, which produced from pit and shafts, 3,271,213 tons. It is difficult to comprehend the size and possibilities of the Hull-Rust pit. Containing over 100,000,000 tons of high grade ore and shipping nearly 3,000,000 tons in its second season, it lends itself to open pit mining in a manner that at present depths at least is almost without a counterpart for cheap and rapid extraction of ore. It has undoubtedly been the bulwark and keystone of the Steel Corporation's mining operations during the past season and was the saving of a critical situation at the time of the miner's strike.

Great Railroad Work.

In the same sentence with the mention of the Hibbing district should be honored the work of the Duluth, Missabe & Northern railroad. Without the remarkable operation of this road in transporting and mixing ores for lake shipment from Duluth, the records of the year, of the Mesabi and of the Hibbing district would have been impossible. Some of the problems of this carrier in handling its 13,445,977 tons of ore have been described in THE IRON TRADE REVIEW and less could not be said than that it forms one of

the most important links in the chain of equipment.

The Hibbing district also provided some notable examples of stripping in both quantity and speed. All records for rapid shovel work were broken in the Sellers pit, when 225,000 yards were removed in a single month by three shovels. This is at the rate of 75,000 yards a month per shovel, which is fully 25,000 yards in excess of what is considered an average run. The record for an individual runner was also made near Hibbing at the Stevenson mine, where in 10 hours, 176 steel cars, carrying 8,054 tons, 624 pounds of ore were loaded. Numerous other marks were made at the Burt, Hull-Rust, Morris, Pillsbury and Hartley pits that outclassed previous performances. Indeed there was probably removed during the year from the Mahoning, Hull-Rust, Burt and Sellers pits, which on three sides surround the town of Hibbing and in fact enter almost to the main street, fully 6,000,000 cubic yards of surface. So completely has the topography of the outskirts of Hibbing been changed by the extension of open pit and underground operations that it has become a problem to reach the town with a railroad. The time is already near at hand when the town site of the biggest city on the range numbering 20,000 inhabitants will be engulfed in the excavating for the ore over which it lies.

Exceptional Achievements.

In several other instances unusual work in removing overburden was carried on, chiefly by the Steel Corporation. At Mountain Iron the already gigantic pit was considerably enlarged, at McKinley, a new pit was opened up and a small quantity of ore shipped, at Virginia work was resumed on the Oliver group involving the conversion of the Oliver, Norman, Ohio and Lone Jack mines into one immense pit. A new pit was also stripped at the nearby Higgins, at Eveleth the milling pit and adjacent forties of the Adams were opened up and shipping begun in November. On the other side of the town, the Fayal was being extended all during the year and a few miles to the southeast the Gilbert was developed. At the west end of the range, the Canisteo, Walker and Holman pits gained enormous size and in all it is estimated that during the year at least 16,000,000 cubic yards were moved on the range.

Most of these operations have been described in detail from time to time in these columns, but the Gilbert and Canisteo are worthy of particular mention in review. At the Gilbert, beginning soon after the first of the year, stripping was commenced and it proceeded against severe handicaps in the character of the surface, at a rate that opened up the mine in a single season, the amount of dirt removed being considerably over 500,000 yards. Before attacking the pit, a deep cut and long approach under the D. & I. R. and D. M. & N. railroads had to be dug, general offices and a large number of houses were erected, large machine shops were built, two shafts were sunk to a depth of 175 feet, the entire plant was equipped on a large scale and a shipment of 100,000 tons was made, all in the space of 10 months beginning with ground that on the first of February had not even been cleared.

At Coleraine the opening up of the Canisteo and the adjoining pits on the Walker lands is the biggest individual undertaking on the range and, from the standpoint of excavating alone, one might safely say in the country; 2,500,000 yards were removed during the year. Some idea of the immensity of the project may be gained from the fact that for a year and a half, from three to six or seven shovels have been digging away the overburdened and not a pound of ore has been taken out of this pit as yet. The scale on which the work of stripping is planned here and elsewhere on the range and the immensity of the operations for which the stripping is but the preliminary must be seen to be appreciated and then only a slight conception of the magnitude of the labor involved is possible.

In addition the other problem of the Coleraine district, that of washing the ore to free it from its excessive silica content, has been experimented with continuously during the year, 5,454 tons have been shipped, and such progress made that undoubtedly washed ores will be shipped in quantity in 1908, if the condition of the ore trade justifies it at all. The ore was mined from Canisteo No. 2 shaft.

The Largest Producers.

The largest producing mines of the Mesabi were the Hull-Rust with 3,271,213 tons, the Mahoning, 1,564,332 tons, the Stevenson, 1,142,977 tons, the Fayal, 1,874,000, the Adams-Spruce, 1,750,000, the Mountain Iron, 1,531,342 tons, the Burt, 1,290,704 tons and the Morris 1,322,313 tons. The number of new properties was also very large in 1907, though some on the following list underwent slight development in 1906. The Steel Corporation has the McKinley, Gilbert, Sellers, Higgins No. 3, Walker and the Ohio, Norman, Lone Jack group of open pits and a number of new shafts on old underground properties. Pickands, Mather & Co. have the Bangor, Syracuse and the Yawkey, with a number of new shafts on other properties. The Republic Iron & Steel Co. has the Mariska, Monica, Onandaga and Fay. The Interstate Iron Co. has the Meadow and Fowler. The New York State Steel Co. has the Kellogg and Knox. Corrigan, McKinney & Co. have the St. James, the Alberta Iron Co. the Alberta and the Spring Iron Mining Co. the Spring. Virginia in particular was the scene of great development with four new shafts and three new open pits. In this district the final settlement of the long controversy over what was known as the Virginia "sliver" is of interest. This is a narrow piece of land adjoining the Sauntry-Alpena property of the Steel Corporation and is now under lease to M. A. Hanna & Co.

Concrete Shafts.

The most important development on the range in the matter of improved methods during the season was the demonstration by the Foundation Co. of the feasibility of concrete shafts and the certainty of its methods of sinking. The sinking of the shafts at the Bangor and Syracuse mines where other methods had failed completely was accomplished without a hitch as fully described in THE IRON TRADE REVIEW. The Foundation Co. is now engaged in sinking a shaft at the Smith mine in the Swanzy district of the Marquette range for the Cleveland Cliffs Iron Co. and its work is looked upon with the utmost confidence.

Most of the exploratory work of the past season on the Mesabi range was carried on in the profiling of known deposits. The bulk of this was, of course, done by the Steel Corporation, particularly on the Walker lands on the western end of the range, where some of the biggest drill camps ever maintained were in existence. The search for new deposits except for a few drills here and there controlled by small interests was largely in the neighborhood of Grand Rapids and to the westward and the exploratory work was rewarded in a number of instances by finding ore of the same general character as that of the Coleraine district. Most of the interests exploring on the Mesabi were not new to the territory, but for the first time Oglebay, Norton & Co., entered

the Mesabi field this year and operated several drills.

Vermilion Range.

The work on the Vermilion range proceeded throughout the year without interruption even during the time when the mines of the Mesabi were tied up by the strike except that shipping was impossible during the time the railroad was not running. The quantity of ore mined, 1,684,894 tons, was slightly less than in 1906, a rather unexpected showing. The further development of the Soudan mine at the 1,200-foot level, the opening up of the White Iron Lake Iron Co. property, where a 6 x 14-foot shaft is being sunk, and the Shagawa Iron Co. operations on section 30 were the only activities outside of the Steel Corporation's routine mining work. The section 30 property was returned to the Shagawa Iron Co. by the Midland Steel Co. and the future of the property is still uncertain, though a very good showing has been made.

Marquette Range.

The season has been one of unusual activity on the Marquette range, in fact, a greater number of mines were in operation than at any time since mining was begun in the district. Work was in progress at 40 mines, of which 34 were producing ore. The return of interest to Marquette range exploration, which began last year, was further developed and the list of old properties reopened is comparatively large. It includes, together with new mines, the Stephenson and Smith at Princeton, the Rolling Mill and Breitung Hem., No. 2 at Negaunee, the Empire and Star West at Palmer, the Boston and Conrad at Clarksburg, the Mitchell at Winthrop, Bessie at Humboldt and Riverside at Republic. Exploratory work on a number of other claims was also carried on.

Most conspicuous among the new shippers was the Maas mine at Negaunee, where the Cleveland Cliffs Iron Co. has been developing since December, 1901. While technically incorrect, it has been remarked that the first ton of ore hoisted from the Maas in July of this year was the most expensive iron ever brought to surface in the Lake Superior district. The ore body is very deep and shaft sinking was unusually difficult, but the deposit is perhaps the largest on the range and the mine is now splendidly equipped.

Cleveland Cliffs Operations.

The Cleveland Cliffs Iron Co. has also done a great deal of work in the Swanzey district during the season, laying out the model town, Gwynn, and clearing out what was a typical upper peninsular forest. There are now four shipping mines of this company in this district, all of which are being opened up on a large scale, the Princeton, Austin, Stephenson and Smith. Besides these, all of which are located within a radius of a few miles, is the Steigmiller belonging to the Steel Corporation, the only 40-acre tract practically in the 40 square miles of the district which does not belong to the Cleveland Cliffs Iron Co. The territory has been well drilled and promises to become a most important part of the range. The other principal operators on the range were M. A. Hanna & Co., Oliver Iron Mining Co., the Jones & Laughlin Steel Co., Rogers, Brown & Co., Oglebay, Norton & Co., and the Cambria Steel Co.

The production of ore from the range was slightly larger than in 1906 and amounted to about 4,100,000 tons. As on the Menominee range also, mines containing high silica ore have been less active this year than last through lack of demand for their ores and as a result the Cascade district of the Marquette range of which the Steel Corporation's Moore mine is the chief producer has been nearly idle. Ores from this range suitable for open-hearth work have been much more in demand this year.

Gogebic Range.

The undertakings of the year on the Gogebic range have been to a great extent in the direction of developing present ore bodies at deeper levels. While the work at the Montreal and Newport is the most advanced in this respect, improvements of the same nature characterize nearly all of the 24 shipping mines of the range. Six steel lined shafts are in progress of sinking, at the Montreal, Aurora, Newport, Geneva, Eureka and Asteroids and one is intended for the Tilden. Most of the mines are now working between depths of 1,000 to 2,000 feet and it is expected that the 2,000-foot levels will open up greater resources than did the upper levels.

The improvements at the Newport in particular have been undertaken on a large scale. A four-compartment steel shaft with a specially designed steel shaft house is being completed. A new power plant has been erected, new high speed hoists installed and the shipping facilities of the mine materially augmented.

The only exploratory work in 1907 that had not been started in the year previous is that of the Reserve Mining Co. between Iron Belt and Upson at the west end of the range. This company represents a number of interests, among them Oglebay, Norton & Co. and the Ashland Iron & Steel Co. The operations at Mellen were also continued. One Atlantic shaft, the Geneva and Asteroids are still in the exploratory stage though some ore was hoisted at both the Atlantic and Geneva. At the extreme eastern end, the Castile Mining Co. reopened the old Comet mine and it will be put in shape again.

Shipments from the Gogebic range by lake during the year were 3,437,672 tons as compared with 3,388,112 tons in 1906. With the all-rail shipments, which will amount to about 275,000 tons, included, the total output will exceed that of last year by nearly 75,000 tons.

Menominee Range.

The Menominee range was during the past season the scene of more searching for new deposits than any other district of the Lake Superior region. The volume of work of an exploratory nature was of course greater in Minnesota, but it was as has been mentioned not of so pioneer a character and was largely the work of one interest. Exploring was confined to the west end of the range, for the most part in the Iron River-Stambaugh section and the Crystal Falls district. Geo. A. St. Clair cleared the titles and did more or less work in the Felch Mountain locality and a few drills were located at the extreme eastern end of the range between Loretto and Waucedah. More new work was in progress in the Iron River-Stambaugh country than at Crystal Falls and it was different in that almost every iron ore interest of the Lake Superior region was represented in close proximity to each other while at Crystal Falls the operations of Corrigan, McKinney & Co. dwarf by comparison the activity of any other interests.

At these two places, Oglebay, Norton & Co. had the Chatham, Lennox and Berkshire of which the Chatham was the only shipper. Rogers-Brown & Co. were working on the Hiawatha, Gibson, Fesing or South Dunn, Chicagoan and Hector, shipping only from the Hiawatha which is an older property. Corrigan, McKinney & Co.

mined a considerable quantity of ore from the Baker, explored the Hoolihan and started shipping from the Kimball and Fairbanks. The Mineral Mining Co. obtained ore from its James property and drilled the Konwinski. Pickands, Mather & Co., in addition to development work on the Baltic and Caspian, were working on the Fogarty and Buckholtz properties. The Huron Mining Co. was shipping from the Youngs and developing the Groveland, Barnett and Wild Cat. The Steel Corporation was less active, confining its attention to the Dober mine and permitting the McGillis exploration to be idle. Work, however, was resumed at the old Mansfield and Michigan mines. The New York State Steel Co. has an option on which it drilled in section 17, 43-34. All these companies have numerous other tracts under option and there is scarcely a forty in the entire district which is not under option to some one. Independent explorations were also more or less numerous. The conditions on the Menominee were inviting to the seeker of new mines when compared with the prices demanded on the Mesabi and the greater shipping distance and greater rail freight rates and the town of Iron River certainly had a bona fide boom aspect.

Aside from the exploratory work more than ordinary interest centers about the completion of the new "C" Ludington shaft, the first steel lined shaft to be put down on the range, and where so much trouble was experienced with water, the curtailment of high silica ore shipments such as come from the Traders and Munro mines, the completion of the power plant and electric transmission system of the Penn Mining Co., and the diverting of the Sturgeon river at the Loretto mine.

Shipments from the Menominee mines were probably slightly less than last year owing to the summary reduction of output in November. Practically all of the Crystal Falls mines were shut down before the end of November and many others were sending out reduced shipments. During the greater part of the year, however, an unusual activity prevailed.

Cuyuna Range.

As a result of the explorations of the Rogers, Brown Ore Co. near Rabbitt Lake, the Cuyuna range, at least in the above locality, has been shown to contain merchantable ore in quantity. This is distinctly a development of this year for heretofore reliable authorities have almost uniformly given out the opinion that the high phosphorus content of the ore and the nature of the formation would keep the Cuyuna range out of the shipping list for several years to come. It is understood now that an annual guarantee of 250,000 tons from this one property is offered to the railroad for an indefinite period. The ore found varies from a very low grade to very high grade with a large proportion of the latter quality. At present the Northern Pacific is the only railroad traversing the range, but reports have pointed to a connection with the Soo line which is now being built to Duluth.

The Rogers-Brown Ore Co. has now acquired considerable land to the south of Rabbitt Lake and with the exception of Cuyler Adams are now the largest land holders on the range. Aside from the work of this company, the situation on the range remains much as it was a year ago though some property changed hands during the summer on the strength of the above showing. This was chiefly through Duluth interests. It is not probable that shipments will be commenced before 1909.

Other Districts.

The Baraboo range has been very quiet during the year with only a few drills operating. The Steel Corporation practically finished its work and the exploration conducted by LaRue and Whiteside brought little to light that was new. Canadian deposits have advanced several steps toward the shipping stage. Shipments are now being made from the Atikokan range to the blast furnace at Port Arthur in sufficient quantity to completely supply it. Shipments from the Moose Mountain and Sudbury districts are only waiting the completion of the Canadian Northern railway to the mines and it is reported that a dock is now being built at Key Harbor to handle these ores. About 75 miles west of the Cuyuna range, Longyear and Bennet have acquired a large acreage and are drilling to prove up the formation shown by dip needle. In general the high prices prevailing and the apparent insatiable demand for ore induced a very active season of development.

The Prospect For Next Year.

For 1908, the prospect in the ore trade is somewhat uncertain. Present appearances point to a much smaller shipment of ore and opinions have been hazarded that not more than 25,000,000 tons will be mined. Underground development may be checked during the winter, but there is little reason for doubting that preparations for open pit work at least on the Corporation properties will go on this winter at a normal rate. Heretofore the time between seasons has been too short for proper preparation on the Mesabi to meet the terrific pace of the mining season and so, with a slower season ahead, winter's work on the same scale as last year will result in the more economical mining of such ore as is taken out. A quiet year in 1908, whatever its great disadvantages might be, would at least tend toward an adjustment of labor conditions to a much more satisfactory basis and would doubtless result in economies in production and more deliberate handling of properties the benefits of which would be felt for several years. Two large independent operations are planned for the winter and next season in the stripping of the Shenango already begun and the proposed stripping of the Susquehanna. These represent the heaviest stripping contracts ever undertaken. The overburden at the Shenango is from 90 to 110 feet deep and that of the Susquehanna, from 100 to 125 feet in an aggregate of six or seven million yards of surface are to be removed. Such tremendous undertakings make the present financial flurry seem insignificant.

NORTHWESTERN IRON CO. SOLD.

The Northwestern Iron Co., Milwaukee, of which Capt. Irving M. Bean has been president and treasurer ror a great many years, has been bought by Ferdinan Schlesinger, also of Milwaukee, who is at the head of the Newport Mining Co. and president of the Milwaukee Coke & Gas Co. Through this transaction this company will have for the output of the Newport and Anvil mines on the Gogebic range a much increased furnace capacity, which will be in keeping with the large development planned for those mines in the next few years. In addition to the furnace plant at Mayville, the coal mines of the Northwestern Iron Co. were included, so that it is understood now that the Milwaukee Coke & Gas Co. will be able to produce and control its own ore, pig iron, coke and limestone. The Northwestern Iron Co.'s properties at Mayville have been owned by the Bean family for more than 50 years, and have a very interesting history. Capt. Bean followed his father Jacob L. Bean in the management of the mine and furnaces and was responsible for many developments. Mr. Shchlesinger will be the new president.

IRON ORES OUTSIDE THE LAKE SUPERIOR REGION

Sources From Which They Come---How They Can be Tested---Possibilities of Development and Beneficiation

By John Birkinbine.[1]

In the following discussion of the iron ores of the United States, exclusive of those won from the mines embraced in the portions of Michigan, Wisconsin and Minnesota, comprising what is generally accepted as the Lake Superior region, no attempt is made to enter into details as to particular districts or individual mines.

The Lake Superior region comprises the most important and productive groups of iron ore mines in the known world, and, owing to the quality and quantity of iron ore obtained from this region, the United States has won pre-eminence as a producer of iron and steel.

The excellence of these ores, and the convenience of ordering them through mining companies from a selected list, has undoubtedly encouraged their transportation to and their use at some plants where near-by ores might have been utilized, but these latter would have made the smelting problem more complex. When a furnace manager must change the furnace burden to meet various conditions of ores, which come to him in comparatively limited quantities, his duties are more onerous than when he can practically lay out a campaign upon a prearranged burden and have supplied to him material maintained in quality and quantity. The dependence upon Lake Superior ores has also permitted the achievement of phenomenal outputs from our blast furnaces, which have encouraged enthusiasm all over the world in the possibilities of iron manufacture.

Before any iron ore was brought from the Lake Superior region, the United States produced pig iron, but on a scale which is comparatively insignificant when compared with the present output of metal. Some of the deposits which furnished ore for the blast furnaces of the country prior to 1854 are still utilized as sources of supply, others have, after periods of inactivity, been rehabilitated, and others have ceased to be productive. Notwithstanding the recognized importance of the Lake Superior region, each year large amounts of iron ore have been won from other localities and used by the blast furnaces of the United States, and to direct attention to these and their possibilities, the following is presented.

The phenomenal development of the Lake Superior ore mines, which have progressed until the exploitations in that district furnish over 79 per cent of the iron ore produced in the United States, has had the effect of dwarfing other sources of supply in various sections of the country; but that these are of moment and importance is evidenced by Table No. 1, which has been compiled from data collected for the United States Geological Survey for the years 1889 to 1906 inclusive, all of which, except for the last year, were compiled by the writer.

Table No. 1.

PRODUCTION OF IRON ORES IN THE UNITED STATES.

Year.	Total Tons.	From Mines Within Lake Superior Region. Tons.	Percentage of Total.	From Mines Without Lake Superior Region. Tons.	Percentage of Total.
1889	14,518,041	7,519,614	51.79	6,998,427	48.21
1890	16,036,043	8,944,031	55.77	7,092,012	44.23
1891	14,591,178	7,621,465	52.23	6,969,713	47.77
1892	16,296,666	9,564,388	58.69	6,732,278	41.31
1893	11,587,629	6,594,620	56.91	4,993,009	43.09
1894	11,879,679	7,682,548	64.67	4,197,131	35.33
1895	15,957,614	10,268,978	64.35	4,688,636	35.65
1896	16,005,449	10,566,359	66.02	5,439,090	33.98
1897	17,518,046	12,205,522	69.67	5,312,524	30.33
1898	19,433,716	13,779,308	70.90	5,654,408	29.10
1899	24,683,173	17,802,955	72.13	6,880,218	27.87
1900	27,553,161	20,564,238	74.63	6,988,923	25.37
1901	28,887,479	21,445,903	74.24	7,441,576	25.76
1902	35,554,135	26,977,404	75.88	8,576,731	24.12
1903	35,019,308	26,573,271	75.88	8,446,037	24.12
1904	27,644,330	20,198,311	73.06	7,446,019	26.94
1905	42,526,133	33,325,018	78.36	9,201,115	21.64
1906	47,749,728	37,876,371	79.32	9,873,357	20.68

This table indicates the rapid growth of the iron ore output of the United States and particularly that of the Lake Superior region, and also the proportion these quantities bear to the total iron ore production of the United States. It demonstrates that in 18 years the mineral obtained from the iron ore mines in the Lake Superior region has been augmented fivefold, while in the same interval the output of other iron ore mines in the United States has increased but 40 per cent. It also shows that in 1889 the iron ore supply of the country was nearly equally divided between the Lake Superior region and the other districts combined, while in 1906 the latter supplied but one-fifth of the nation's total. But the iron ore mines without the Lake Superior region now annually furnish as much iron ore as is obtained from any other country, except Great Britain, Spain and Germany. The quantity of iron ore obtained in 1906 from them, 9,873,357 tons, also represents about 84 per cent of the total production of iron ore in the United States in either of the years 1893 or 1894. These statements appear sufficient to suggest that this portion of the iron ore industry is important. The supply from the iron ore mines distributed over a number of states may be expected to increase in the future, and within late years a number of mines, which have lain dormant, were exploited, and some exploratory or development work done on other deposits, which have been known but not wrought.

As indicated above, the abundance of iron ore in the Lake Superior region; its practical freedom from sulphur; its relatively small average increment of phosphorus (a considerable portion of the ore being of Bessemer grade); its occurrence chiefly as red hematite, which responds easily to furnace management; the large scale on which the deposits are wrought; and the facilities provided for handling and shipping ore, have done much to encourage its use, even in portions of the country where other ores are found in quantity, as in eastern Pennsylvania, New Jersey, Virginia, etc.

The fact that 100,000 tons of iron ore were shipped from Minnesota to Colorado in 1905 is merely an incident of distribution, for this was obtained to meet a temporary local deficiency in ore supply caused by the time taken in developing some of the deposits in Wyoming belonging to the Colorado Fuel & Iron Co. The Lake Superior ores, however, may be considered as being used

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regularly in furnaces in Missouri, West Virginia, southern Ohio, Virginia, eastern Pennsylvania, and New Jersey, where local ores abound, in addition to what is regarded as their natural market, the various ports on the great lakes, eastern Ohio, western Pennsylvania, and western New York.

Whether all these distant shipments were matters of necessity is questionable, for, taking the market prices which have prevailed at lower lake ports for Lake Superior ores, and adding to these the freight charges for a long haul, it is doubtful whether in some instances cheaper pig iron could not have been produced by mining and using local ores than by the employment of Lake Superior ores.

The mineral which is now obtained outside of the Lake Superior region is widely distributed over a portion of the United States in deposits of various size and character, a number of which give promise of liberal desirable reserve for the future. It is questionable whether there is a state in the nation from which iron ores have not been, or may not be, obtained, and the states which are actually contributing to the present supply number 25.

A resume of the sources from which iron ore is won in quantity, and some suggestions as to the future, are presented, the ores being treated as generally classified for commercial purposes, viz., magnetites, red hematites, brown hematites and carbonates.

The statistical data collected by the United States Geological Survey have been, and are published by states, as it seemed essential to recognize the political divisions of the country, but from a practical business standpoint the ore supplies and their distribution are more properly treated by districts, which may be portions of a single state or a combination of several states. In this review, therefore, an effort is made to treat the iron ore supply and its utilization as they affect districts, and also to recognize the state boundaries.

Brown Hematites.

Brown hematites are won on a moderate scale from southwestern Massachusetts, northwestern Connecticut, and eastern New York, in what is known as the Salisbury region, which has for many years produced a special grade of charcoal pig iron mainly applied to car wheels and chilled castings. They are obtained in more liberal quantities in eastern Pennsylvania, and some is won in western New Jersey, forming portions of the burdens of the blast furnaces in those portions of these states. Alabama, however, is the largest producer of brown hematite ore, followed in order by Virginia, Tennessee, and Georgia. Some of this class of ore is also obtained from Missouri, Texas, Wisconsin, Colorado, Montana, Kentucky, Maryland and West Virginia. Of the total brown hematite (2,781,063 tons) produced in 1906, 62 per cent was mined in Alabama, Georgia and Tennessee, and 26.5 per cent in Virginia; in fact, over 88 per cent of all the brown hematite ore mined came from the southern states.

Red Hematites.

The most prominent producer of red hematite, next to the Lake Superior region, is the state of Alabama, furnishing about 3,000,000 tons annually, and next in order is the state of Wyoming, then Tennessee, New York, Georgia, Virginia, Missouri, New Mexico, Kentucky and Pennsylvania. The red hematites of Alabama have been the mainstay upon which the large pig iron industry about Birmingham has been developed, being used in association with brown hematites in making up the furnace burden. There were 3,559,374 tons of red hematite obtained in Alabama, Georgia and Tennessee, and 1,045,630 tons from all other states outside of the Lake Superior region in 1906. Owing to the interdependence of the three states named, the brown hematites may be combined with the red hematites, the output in 1906 being 5,277,062 tons, which were responsible for the production of about 2,300,000 tons of pig iron.

The Wyoming ore deposits give promise of an augmented supply. These ores in connection with those from New Mexico to the extent of 800,000 tons per annum are used in the blast furnaces of Colorado. There are numerous exploited deposits of red hematite in the United States, which by reason of their locations have not been wrought or have produced but little ore; this is especially true of the western section of the country; there are also red hematite deposits in Texas and in the eastern States which have lain dormant on account of the abundance and ease of securing Lake Superior ore of this character.

Magnetites.

The bulk of the output of the northern Atlantic states is magnetite, New York supplying in the neighborhood of 1,000,000 tons, Pennsylvania furnishing 800,000 tons, New Jersey 500,000 tons, the balance of the magnetite which goes to make up the total for the United States of 2,469,294 tons coming from the western states, North Carolina, and Virginia.

The Lake Champlain region of northern New York supplied some phenomenally rich ore, but a considerable part of the mineral mined is enriched or dephosphorized by magnetic concentration. Some of these Lake Champlain deposits exhibit evidences of reserves of magnitude and in addition to properties which have been wrought there are others which are known to contain large quantities of ore. Arrangements are now in progress for the exploitation of a deposit of titaniferous ore, which is considered to be of phenomenal extent. It was wrought many years ago on a moderate scale and the experiments made by A. J. Rossi point to a possible utilization of this class of ore with advantage and profit.

In the highlands of eastern New York there are a number of deposits of magnetite which have been more or less exploited, and some of these are being rehabilitated. The extent of these deposits encourages their use, although much of the ore will have to be treated to enrich it or to remove sulphur or phosphorus. However, the expense of such treatment may be considered as below the freight charges on other ores for long hauls. The existence of a deposit of magnetite in Rhode Island has long been known, and it is possible that the recovery of iron ore from the black sands of Long Island Sound may become a source of profit.

In New Jersey there are a few mines of importance, some of the ore being obtained from deep workings, which are operated on a limited scale.

In Pennsylvania the Cornwall ore hills, which have continued to furnish magnetite for more than 160 years, are actively wrought. This ore is sulphurous and demands roasting, but is of Bessemer grade as to phosphorus. A large expenditure is being made at this deposit to provide for liberal exploitations in the future, and some of the ore is being concentrated magnetically and the sulphur removed by nodulizing.

Other magnetic deposits in eastern Pennsylvania have liberal reserves of ore and may be expected to contribute towards the supply in the future. Deposits are wrought in Virginia and North Carolina and the reserves of these will undoubtedly be drawn upon in the production of pig metal.

Magnetite is found in Wyoming, Colorado, New Mexico and other western states, and has been and can be obtained from the Lake Superior region.

Carbonates.

A small amount of carbonate iron ore is mined in the state of Ohio and demands merely passing notice. Carbonate ores are also found in New

York, Pennsylvania, West Virginia, Kentucky and Maryland.

In Table No. 2 (compiled from the United States Geological Survey report of 1905) is epitomized the output of the various classes of ore in the different states for that year. During the year 1906, the reported product of the mines in the United States outside of the Lake Superior region was 670,000 tons in excess of that for the year 1905; but, owing to the detailed knowledge of distribution for the previous year being at hand and the purpose of the table being to indicate distribution by states and the character of the ore, the figures for 1905 are used.

Table No. 2.

Distribution of Iron Ore Production by States in 1905, Excluding Lake Superior Ores, Long Tons.

State.	Brown Hematite.	Red Hematite.	Magnetite.	Carbonate.	Total Quantity.
Alabama	781,561	2,974,413	26,857	.....	3,782,831
Arkansas and Texas	27,668	.....	.....	.....	27,668
Colorado	131,317	2,154	.....	.....	133,471
Connecticut and Massachusetts	25,931	.....	.....	.....	25,931
Georgia	155,434	45,408	.....	.....	200,842
Iowa	100	.....	.....	.....	100
Kentucky, Maryland and West Virginia	17,954	25,000	.....	2,010	44,969
Missouri	34,266	78,746	.....	.....	113,012
Montana, Nevada, New Mexico, Utah and Wyoming	14,174	557,619	118,838	.....	690,631
New Jersey	.....	.....	526,271	.....	526,271
New York	9,266	80,020	1,050,651	.....	1,139,937
North Carolina	.....	.....	56,282	.....	56,282
Ohio	.....	.....	.....	19,989	19,989
Pennsylvania	166,435	4,425	637,857	.....	808,717
Tennessee	461,774	272,996	.....	.....	734,770
Virginia	704,470	35,357	518	.....	740,345
Wisconsin	16,307	139,062	.....	.....	155,369
Total	2,546,662	4,215,200	2,417,274	21,999	9,201,135

The foregoing statements and statistics suggest the importance of various sections as present producers and also as future sources of iron ore, for in some of the districts which have furnished iron ore for many years in moderate quantities, there are indications that systematic exploration; such as is carried on elsewhere, may bring to notice and development large amounts of ore now only suspected.

Methods of Beneficiating.

Many of the ores without the Lake Superior region demand some preparation to make them attractive to the blast furnace managers. Brown hematites, as mined, require washing, and roasting some of these ores has proven to be advantageous and desirable. Carbonates need roasting to drive off the carbonic acid. Impure magnetites demand concentration, either by jigs or magnetic separators, and when the concentrate is finely divided, briquetting or nodulizing is necessary. Sulphurous magnetites must be roasted.

Any method of beneficiating necessitates attention to detail and the expense incurred in the processes must be added to the cost of the ore mined. But practically all ores are now valued at the blast furnaces on the basis of the units of iron contained, with allowances for phosphorus, sulphur, moisture and physical conditions, and the costs of beneficiation which is warranted for any ore is determinable within narrow limits. some processes this expense is reduced by a credit from by-products. Thus, in northern New York the apatite removed for the purpose of reducing phosphorus in magnetites finds a ready sale as a fertilizing medium, and in central Pennsylvania the copper, and to some extent the sulphur in the tailings from magnetic separators is sold to advantage. In other instances, the sand in the tailings from magnetic separators is disposed of profitably.

During the late Lewis & Clark exposition at Portland, Ore., systematic investigations of iron sands were carried on by the United States Geological Survey, and some of the concentrates from this sand were smelted in an electric furnace.

The above suggests the possibility of beneficiating many ores which are now unutilized, or which are wrought only on limited scale.

A fair estimate of the cost of transporting Lake Superior iron ores from the mines to lower lake ports approximates 2½ cents per unit of iron to which must be added royalties, mining costs, profit, and freight to consumers. It would therefore appear that other ores may be mined and, if necessary, beneficiated and delivered to near-by furnaces in competition with Lake Superior ores.

The titaniferous iron ores of New York, New Jersey, the Carolinas, Colorado, Wyoming, and other states, also offer a large supply of a mineral which has received but little attention.

The augmenting demand for Lake Superior ores, the prices which they command, and the anxiety expressed as to their sufficiency for the future, will encourage the development of iron ore mines elsewhere, and the treatment of such ores as may require beneficiation.

In no country is the average iron contents of ores used so high as in the United States, and if mineral as lean as the domestic ores of Great Britain and Germany were employed in this country, numerous deposits now unwrought or undeveloped would become producers.

As a matter of fact, ores yielding but 30 per cent of iron have been utilized in American blast furnaces, large quantities carrying under 40 per cent are now used, and the average yield of all the iron ores fed to blast furnaces in the United States approximates 50 per cent. Well washed brown hematites will average 43 per cent, and concentrated magnetites averaging 60 per cent or over of iron are sold in quantities to blast furnaces.

Except for the ores which have been exploited by the Colorado Fuel & Iron Co. but little is known concerning the supply which may be obtained from the Rocky Mountain region and the great territory between it and the Pacific ocean. Some of these western deposits, however, known to be of large extent and good quality, await future development. But in the eastern and southern states "new finds" of iron ore are reported and any apparent deficiency in present sources of supply will encourage development of these, rehabilitation of abandoned mines, or increased output from those which are now productive.

C. E. Morris, of C. E. Morris & Co., Columbus, O., manufacturers of structural iron, says he does not look for any decided revival of business under six months. Architects have very little new business in.

MERCADO'S HILL, MEXICO

Immense Deposit of Iron Ore Which Has Long Been the Pride and Hope of People Who Looked for Another Pittsburg

(Special Correspondence.)

City of Mexico, Dec. 20.—Rising from the bare and sun-burnt plain, dotted with giant prickly pear plants and dwarf shrubs of the desert, upon the outskirts of the city of Durango stands the great iron ore deposit, known as the Cerro del Mercado. For centuries past this natural phenomenon has been the pride and hope of generations of people living in the district, and the dream of seeing a second Pittsburg arise at the base of the towering mound as the natural result of the utilization of the immense body of mineral wealth in extensive iron and steel manufacturing establishments, a dream which was born at the first attempt at iron making at the works near by, has been cherished for more than half a century.

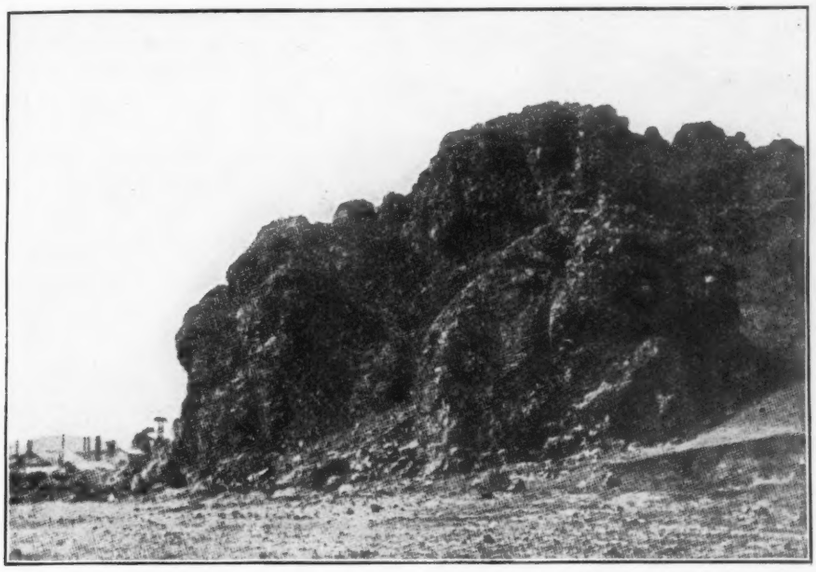

FIG. 1—OUTCROPPING OF ORE ON FRONT FACE OF HILL, SHOWING BROKEN FORMATION.

The only visible manifestation of this ambitious hope at present consists of the hill itself and a one-story, whitewashed adobe tienda, or store, some 20 feet in front and running back perhaps thrice that distance, into a corn patch. With the exception of the works, formerly carried on by the Mexican National Iron & Steel Co., and which has been idle for more than two years, the building referred to has the site of the great future city all to itself. Upon its front and side, in letters a foot long, may be read a single but significant word—"Pittsburg." Across the wide stretch of road in front of the house a dozen peons are picking ore from shallow workings in the surface at the base of the hill, and loading it into iron hand cars. The ore is shipped to smelters at Monterey, Aguascalientes and other points to be used as a flux. Rising to a considerable height above these workers is seen the rugged mass of ore outcropping illustrated in Fig. 1. This is not the hill proper, but an adjoining mound.

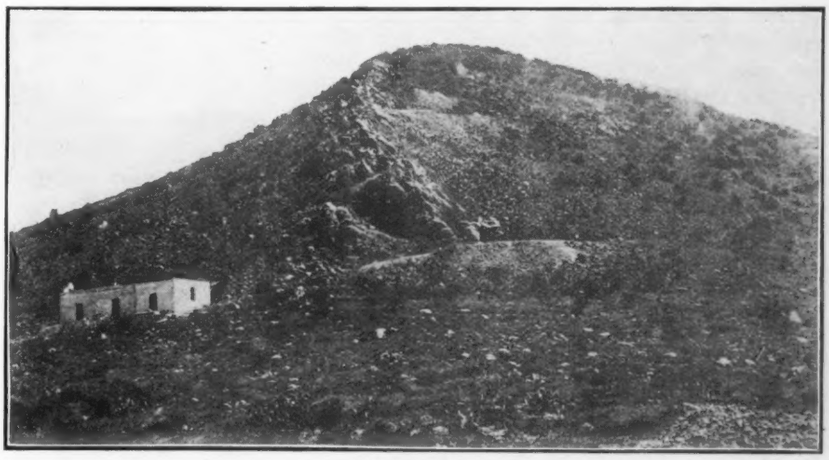

FIG. 2—VIEW OF HILL, SHOWING MINE OPENING AND DUMP.

In Figs. 2 and 3 are illustrated two views of the Cerro del Mercado, the former showing where an opening has been made into the hill and the dump.

Some little distance around the knob, shown in Fig. 1, at the time of the writer's visit, a second gang of workmen was encountered quarrying into the side hill, facing the works, which are seen at the left in the same illustration. Blasting was in progress and a quick run to a place of security was necessary. The ore quarried is dumped at the side of the spur track which runs through the yard of the works and transported to distant smelters. In the works themselves, there was absolutely no movement, except in the way of disintegration.

This iron ore body, which is generally believed to be one of the largest in the world, has been frequently described in its technical aspect. Most of the "write-ups," however, both technically and historically, have been erroneous and unsatisfactory. The *Mexican Herald* in a recent issue, reproduces an article contributed to the *Mining Journal*, of London, by Edward Halse, A. R. S. M., which it endorses as being "historically and mineralogically correct." The following extract is taken from Mr. Halse's article:

Mercado was a wealthy dweller in Guadalajara, and the owner of sundry rich mines in Tepic, and rumors of the occurrence of gold and silver deposits in the valley, afterwards called Guadiana, having reached the ears of the Audiencia de Compostela, he was nominated captain-general of that body, and in 1522 sallied forth, at the head of 100 Spaniards, on his military prospecting expedi-

tion. An Indian of Tepic acted as guide, and conducted him first to the mines of Xocotlan. Then he heard from other Indians met with on the road of the existence, somewhere about, of a mountain of gold and silver. During the quest of the golden mountain, he had various skirmishes with Indians. In Xocotlan he had been surrounded by some 6,000 of them—and, after discovering mines in Chalchihuites, Sombrerete, San Martin and Avino, of which he took little notice, at last he reached the famous Cerro, only to find to his disgust, that it was composed of nothing more precious than iron. Needless to say, he speedily turned his back on what his soldiers had sarcastically dubbed on the spot "El Cerro de Mercado."

In 1857 F. Weidner made various expeditions to the mountain, on behalf of the Mexican government, and was the first to publish a more or less scientific description of the deposit. His report first appeared in 1858, a second edition, enlarged and amended, accompanied by a colored geological section, followed in 1877. The latter report and section are still of great interest and value, although the nomenclature of the rocks is now antiquated, and some of the ores and minerals are incorrectly described.

In 1864, according to Guillemin-Tarayre, the deposit was being worked on a very small scale, one small forge supplying only the immediate needs of the locality.

Among the later writers who have described the Cerro de Mercado may be mentioned L. Kleinschmidt, John Birkinbine and M. F. Rangel.

John Birkinbine examined the mountain on behalf of an American company in 1882. In his report this authority pronounced it "the most extensive known single deposit of iron ore in the American continent, or, possibly, in the world." These words were no doubt correct at that time, but the subsequent discovery of the huge "Las Truchas" deposits, near the boundary of Michoacan and Guerrero, has, if reports are true, put the Cerro de Mercado in the shade.

Witherbee estimated the ore of the Durango deposit at 360,000,000 tons "in sight." Robert Hay Anderson states that according to a detailed survey recently completed, "Las Truchas" outcrop shows 1,069,081,857 tons, requiring no sorting, so that the latter deposit contains roughly three times as much as the former.

Birkinbine took several hundred samples of the Durango deposit. McCreath's analysis of the average of all samples from 10,000,000 square feet of surface is: Magnetic oxide of iron, 2.71; ferric oxide, 77.571; manganic oxide, 0.113; titanic acid, 0.71; lime, 5.050; magnesia, 0.364; sulphuric acid, 0.212; phosphoric acid, 3.041; loss of ignition, water, etc., undetermined, 1.124—100,000; giving metallic iron, 55.8; manganese, 0.079; sulphur, 0.085; phosphorus, 1.328.

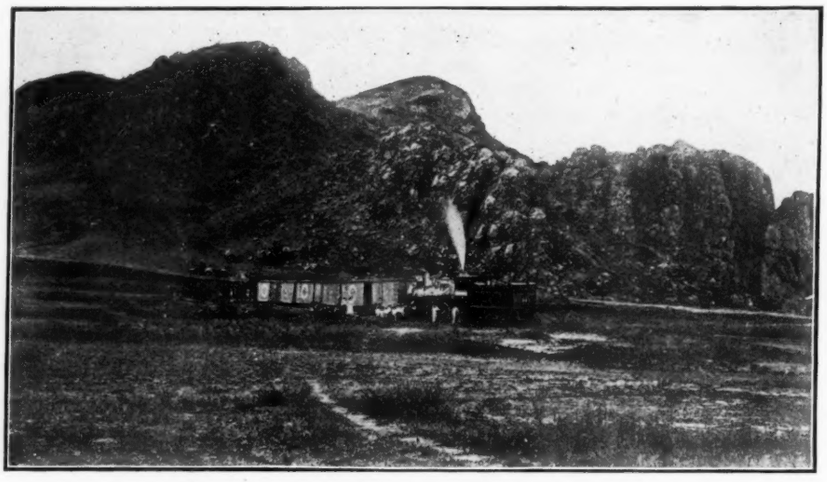

FIG. 3—ANOTHER VIEW OF THE HILL.

Birkinbine found numerous specimens covered with octahedral crystals (the "magnetite" of older writers) which gave the red streak of specular ore. These he submitted to Professor B. Silliman, who pronounced them to be martite.

Thus for more than 50 years the ore had been quarried on a small scale and smelted intermittently in a cold blast furnace. In 1882, however, the Mexican National Iron & Steel Co. acquired the greater portion of the mountain, and commenced the new year by erecting there a large plant of modern type. Operations were not successful until 1888, but the production has been steady since 1900. In 1902 a large fire occurred at the works, destroying a portion of the plant; the following year the latter was rebuilt, and the whole further enlarged and improved.

According to M. F. Rangel, the Cerro de Mercado, three kilometers north of Durango city, strikes E. W., and is 1,500 meters long; the width is variable. (Witherbee gives it as one-third of a mile), the western extremity being very wide and the eastern end very narrow; the average height above the plains is 300 feet, one or two peaks standing up another 100 feet or so above the average height.

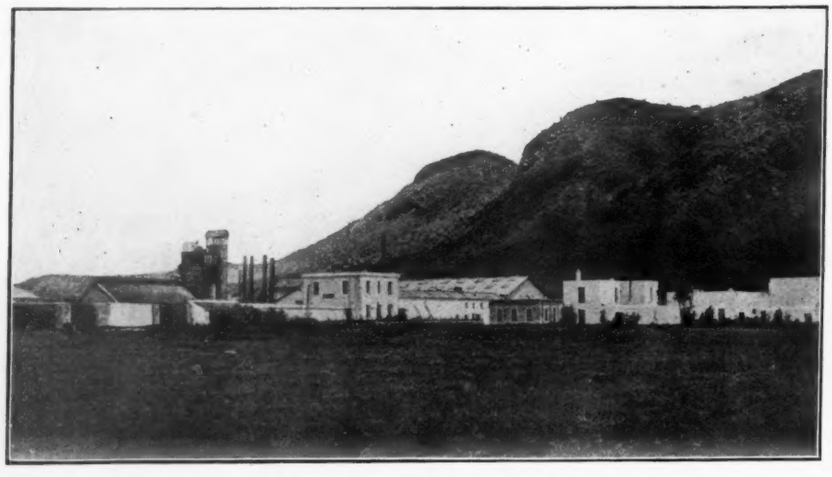

FIG. 4—GENERAL VIEW OF WORKS OF THE MEXICAN NATIONAL IRON & STEEL CO.

The mineralized portion of the Cerro de Mercado is in the form of a very powerful dyke, split up in the western portion, where two branches go off to the north. The encasing rock is rhyolite. Erosion has produced the disintegration of the latter into blocks of different sizes, which have been deposited on the slopes of the mountain. The exposed mineral has become disintegrated into fragments of different sizes, which form a superficial layer of the rhyolite blocks, thus giving the mountain the appearance of being formed entirely of iron ore. The illusion vanishes, however, on careful examination. At the base are enormous beds of compact rhyolite; further up is seen the deposit of rhyolite fragments, still further up, the latter, covered on some faces with iron ore crystallized in small octahedra (martite) are mixed with pieces of compact ore, the proportion of which increases with the height, until the whole deposit is formed exclusively of the latter. The same thing is found at the foot of the bluffs formed by the outcrop. It is only where the slope of the mountain is great, or where the actual outcrops reach the level of the valley, that the iron ore covers the slopes of the mountain to its base.

The predominating ore is hematite, which appears in granular compact masses of immense dimensions, marked by various contraction-planes, which divide them up into smaller portions. On the faces of separation of the different fragments are seen large octahedral crystals of martite, and frequently well-formed crystals of apatite. The specular and micaceous varieties of hematite are found in little veins, either in the compact ore, or more frequently encased in the rhyolite.

SOUTH SHARED YEAR'S PROSPERITY

And Also is Feeling the Present Depression---Large Percentage of Production Used at Home---The Future Not Clear.

By Jos. D. Morton.

Buying of southern pig iron for the year 1907 began in August of 1906 on the basis of $14, Birmingham, for No. 2 foundry. A heavy tonnage was sold in August and September of 1906 with prices for the first half of 1907 advancing rapidly, reaching $16 in October and $20 in November. In November of 1906, the tonnage for the first half of 1907 was practically sold up, and buying for the second half of 1907 commenced at $17.50 Birmingham.

The year 1907 opened with consumers well covered for the first half of the year, but with cars scarce, and deliveries on contracts not meeting expectations, spot iron was commanding $23 Birmingham. The melt was heavy and consumers were calling for iron on contracts with furnaces unable to get it loaded or moved owing to the scarcity of cars. There was much dissatisfaction on the part of buyers, as they were compelled to go into the open market and buy spot iron at $23 while they had unfilled contracts from $14 up to $18 Birmingham. This condition of affairs continued through the months of January, February and March. In February there was an accumulation of iron on the yards of southern furnaces owing to lack of cars and the railroads announced an advance in freight rates of 25 cents per ton to take effect Feb. 1. This was vigorously resisted by the pig iron interests as being manifestly unfair and the advance was postponed until March 1. There was no improvement in shipments during February and the advance was again postponed until April 1, when it took effect. Shipments improved in March and April, spot iron began to show weakness and by the first of June quotations were $21.50 Birmingham, a decline of $1.50 per ton since the first of the year.

In the first quarter of the year, consumers were not inclined to cover for the second half of 1907 at $18 to $18.50 Birmingham, but toward the close of April there was more interest in second half requirements and on the first of May there was a rush to cover which sent last half prices up to $19 and $20 Birmingham. At this time there was talk of covering for the first half of 1908.

The course of the market up to the first of June had the effect of making producers in the south over-confident and firm holding of all deliveries and the turning down of business at good prices were the order of the day. The market had advanced so rapidly that there was belief that all the southern production would be needed to cover the requirements for the last half of the year. Some producers refused to commit themselves for forward delivery at any figure, relying on a spot market to take their iron.

In June and July, deliveries on contracts began to be good with furnaces catching up on their delayed shipments and spot iron weakened steadily. In July, consumers who had iron coming to them at $18 and $18.50 Birmingham, began to offer these contracts for resale or to dispose of the arrivals on the spot market and take in the profit, believing that they would be able to replace the tonnage thus sold out at a lower figure at such time as they would need the iron. This tonnage coming out on a dull market against such free iron as the furnaces had to offer resulted in bringing spot and contract iron down to the same level by Sept. 1. Interest in contracts for 1908 had by this time disappeared and there was no inquiry for 1908 delivery.

The market held fairly steady during September and most of October but during the latter part of October all prices were lower and November brought about decided declines.

It is difficult to say just what furnaces in the south averaged at furnace during the year for their iron as it is not clear to what extent they participated in the high spot premiums. The bulk of the contracts for delivery in the first half of the year averaged about $15 Birmingham and for the last half about $18 Birmingham for No. 2 foundry. This would make it appear that southern furnaces averaged about $16.50 to $17 Birmingham for No. 2 with the general average perhaps somewhat under these figures, counting in the lower grades and the condition of the market at the close of the year. As a general proposition, it is likely that $16 Birmingham would represent the average net figure for No. 2 foundry for the year 1907. The average for all grades would be below this as there was a wider difference between the grades this year than usual.

Southern consumption of pig iron made decided increase during 1907, and from an excellent source it is estimated that 60 per cent of the southern production was used in the south, leaving only 40 per cent to be marketed in the north. The production was large as the high prices stimulated activity to the utmost and allowed even the most expensively operated stacks to run. The cost of production was higher than in 1906 as the ores did not yield so well and labor and coke were much higher in price.

The year closes with the country recovering from a financial panic. Buying has practically stopped and order books for 1908 are without an entry in many cases. Southern No. 2 foundry has declined to $13 Birmingham. Foundry melt is very light and the outlook for 1908 is so uncertain as to make all interests cautious. Furnaces in the south are blowing out under the lack of demand for iron and the inability to make collections to furnish funds to keep in blast. What 1908 has in store is by no means indicated by anything tangible and the iron industry is waiting developments from day to day.

Prices of Southern Iron (Spot).

Date, 1907.	Southern No. 2 Birmingham.	Gray Forge Cincinnati.
January, average	$23.00	$22.60
February, average	$23.00	$22.50
March, average	$22.75	$22.72
April, average	$22.00	$21.50
May average	$21.40	$21.90
June, average	$21.25	$21.37
July, average	$20.50	$20.56
August, average	$19.80	$19.95
September, average	$18.12	$18.86
October, average	$17.65	$18.45
November, average	$16.00	$17.37
December, average	$14.12	$15.56

MEMORABLE ERA OF BLAST FURNACE BUILDING

Prediction Made That the Country Will Never Again See a Period of Such Extensive New Construction of Stacks to Use Lake Superior Ores

By B. E. V. Luty.

It is eminently fitting that a review of recent new blast furnace erection should be given at this time. There is just closing an era in furnace erection which is destined to be memorable in the annals of the American iron and steel industry. In the first 10 months of 1907, there were completed and blown in absolutely new blast furnaces with an annual capacity of more than 2,000,000 tons of pig iron, while, had no industrial depression intervened, there is no question that the work in hand would have resulted in the completion and blowing in, during the following eight months, of furnaces having an annual capacity of more than 2,500,000 tons, a total of absolutely new furnaces completed and blown in during 18 months from Jan. 1, 1907, to July 1, 1908, of close to 5,000,000 tons of annual capacity. The work of completion and blowing in of the additional furnaces is delayed, but that is only a detail; the great era is made by the work having been entered upon, and is made more distinctive by this very delay, which will naturally preclude the projection of fresh blast furnaces for a considerable time.

This era of blast furnace construction will be memorable on account of its magnitude, but it appears clear that it will prove memorable for another reason. The American iron industry has not ceased growing; in the future there will be many great eras of new erection as the industry continues to expand, but the writer is firmly of the opinion that the era just closing will prove to be the last great era of new blast furnace erection, based upon Lake Superior ores. Occasionally new furnaces will be built to use Lake Superior ores, but the next great development will be for the purpose of using other ores, from sources outside the Lake Superior region as at present known. This seems to be a pretty clear prospect, from a survey of the situation as it exists today. Unquestionably the United States Steel Corporation is better fortified than others with Lake Superior ores, so that, if a case can be shown with it, the subject can be dismissed. With the blast furnaces the Steel Corporation now has under way, the rebuilding of such of its old furnaces as require rebuilding, and the increase in output per furnace which seems destined to continue with improvements and refinement in practice, the Corporation will easily work up to an output of at least 15,000,000 tons of pig iron a year, without the erection of distinctly new furnaces. That will require 30,000,000 tons or more of Lake Superior ore a year, as the ores are likely to run. The current report of the United States Geological Survey places the total known reserves of the Lake Superior region at between 1,500,000,000 and 2,000,000,000 tons, crediting the Steel Corporation with the control of about three-fourths. At 30,000,000 tons a year this would give the life of the Steel Corporation's reserves at 37 to 50 years. The conservativeness of 30,000,000 tons a year as an estimate of the requirements, without absolutely new blast furnace erection, ought to balance the prospects of enlargement of the known reserves as developments of the ore bodies are made from year to year.

The Steel Corporation has a large amount of capital tied up in blast furnaces, railroads, lake vessels and ore docks, all predicated directly on the use of Lake Superior ores. To increase the annual movement much beyond that here contemplated would involve the expenditure of large sums of additional capital, only to shorten the period of utilization and hasten the day when the equipment would suffer a depreciation of, possibly, close to 100 per cent. One cannot expect a new and adequate use to spring up for this equipment when the ore is no longer available. A continuance of increase in the annual consumption, even at a much lower rate than prevails in this period of expansion, would greatly decrease the period of utilization, and at the same time greatly increase the amount of investment which would be rendered useless through the exhaustion. The Steel Corporation is increasing its rate of ore consumption in this movement by, say, 15 per cent a year. At a rate of increase of only one-third of this, it would double every 15 years. In only one 15-year period it would get up to, say, 60,000,000 tons of ore a year, and the investment of double the present would have only, perhaps, from 15 to 25 years to run, after which the equipment would become almost useless.

It seems quite certain, therefore, that there will never again be a rush of new blast furnace erection, based upon the Lake Superior region as now known. There are likely to be slight increases now and then. One can see a prospect, without much increase in equipment, for an annual movement of 50,000,000 tons of Lake Superior ores, but at the height of the movement the figure is not likely to pass much above this. Probably it will work up to a point somewhere between 50,000,000 and 75,000,000 tons a year, and then begin to dwindle.

If many blast furnaces are built at the head of the lakes, the total consumption may be increased, without the expenditure of much if any capital in transportation properties.

The other interests using Lake Superior ores have less reason than the Steel Corporation to increase greatly, in the future, their rate of utilization, so that it seems evident that the present great era of building of blast furnaces dependent on Lake Superior ores will prove to be the last.

The 1902 Crop of New Furnace Projects.

The acute scarcity of pig iron in 1902 led to the projection of a large number of new blast furnaces. To bridge over the period until the new furnaces could be productive, heavy imports were resorted to, the monthly imports passing 100,000 tons in the three months, November and December, 1902, and January, 1903, while nearly 1,000,000 tons were brought in on the whole movement, from July, 1902, to June, 1903, inclusive. The additional iron provided by the importations and by the new blast furnaces which were projected in 1902 and the early part of 1903 was not all needed and the American iron trade found itself confronted, in the third quarter of 1903, with a plethora of pig iron, both as to iron actually on the ground and as to prospective make. In the 12 months prior to

July 1, 1903, it had made 18,720,100 tons, and had imported 956,198 tons, a total supply of about 19,675,000 tons, whereas in the first half of 1902 it had made 8,808,574 tons and imported 115,607 tons, providing a supply at the rate of about 17,850,000 tons a year. A considerable part of the pig iron just imported lay on the ground, there were imports yet to come in, to cancel which engagements strenuous but unavailing efforts were made, and there were large additions to capacity soon to be ready. The result was the well remembered collapse late in 1903.

Many of the blast furnaces projected in 1902 and the early part of 1903 were completed and ready to blow in during the early part of the lull of 1904, but had to lie idle until demand revived. In 1905 came the belated blowing in of the last of the 1902-3 crop of new furnaces. Naturally a quietus was put on the erection of new blast furnaces by the spectacle, in 1904 and the early part of 1905, of so many new furnaces lying idle in a completed or almost completed condition. There were 10 new blast furnaces blown in during 1905, with an annual capacity of nearly 1,500,000 tons of pig iron, and practically every one of them had been projected in 1902.

Beginning of the Present New Erection Period.

Thus it took a much longer time than expected to harvest the crop of new furnaces projected in 1902 and the early part of 1903. The enormous demand for pig iron in 1905, however, leading to a production in that year of almost 23,000,000 tons, nearly 5,000,000 tons in excess of the best previous make in a calendar year, and promising a much greater demand in succeeding years, showed that many more blast furnaces would have to be built, and plans immediately began to be laid for many new blast furnaces.

Having thus drawn the line of demarkation between the crop of new furnaces projected as a result of the heavy demand in 1902, and the crop projected as a result of the heavy demand in 1905 and later, we present data of new furnaces as they were blown in.

It must be explained that this article treats exclusively of absolutely new blast furnaces. Blast furnaces are being rebuilt and improved all the time. Sometimes an old furnace is abandoned and an entirely new one built on the same location. Even such furnaces are not considered, although the improvement, rebuilding and replacement of old furnaces more than make up for the loss of the country's total effective capacity through the general deterioration. These data refer only to entirely new furnaces, on new ground, and designed to increase capacity, not in any sense to replace old capacity.

New Furnaces as Blown In.

The following table includes the new furnaces blown in during the past three years:

1905—First Half.

Jan. 1—Pine Lake, Boyne City, Mich. (Charcoal.)
Jan. 3—Donora No. 1.
Jan. 21—Lackawanna No. 4.
Feb. 7—Donora No. 2.
Feb. 22—Lorain D.
April 28—Ensley No. 6.
June 23—Woodward No. 3.
Total, first half 1905: 7 furnaces, 974,000 tons annual capacity.

Second Half.

July 5—Buffalo-Susquehanna No. 2.
Sept. 3—Lackawanna No. 5.
Dec. 28—Tube C, McKeesport.
Total, second half 1905: 3 furnaces, 482,500 tons annual capacity.

1906—First Half.

Jan. 18—Cambria No. 7.
Jan. 21—Mingo No. 4.
Mar. 6—Cadillac, Mich. (Charcoal.)
May 1—Lackawanna No. 6.
May 27—Burden, Troy, N. Y.
June 25—South Chicago E.
Total, first half 1906: 6 furnaces, 825,000 tons annual capacity.

Second Half.

Sept. 6—Midland, Pa.
Sept. 12—Joliet No. 4.
Sept. 15—Palmerton No. 2. (Spiegel from zinc residium.)
Oct. 15—Haselton No. 2.
Total, second half 1906: 4 furnaces, 430,000 tons annual capacity.

1907—First Half.

Jan. 1—Haselton No. 3.
Jan. 9—Toledo No. 2.
Jan. 14—Josephine.
Feb. 1—Federal No. 1.
Feb. 12—Lackawanna No. 7.
April 15—Bethlehem E.
May 2—Minnequa F.
May 15—Mayville, Wis.
June 3—Carrie No. 6.
June 16—Perry, Erie, Pa.
Total, first half 1907: 10 furnaces, 1,340,000 tons annual capacity.

Second Half.

Aug. 2—Carrie No. 7.
Aug. 8—Cambria No. 8.
Aug. 31—Madeline, Indiana Harbor, Ind.
Sept. 26—Lorain E.
Oct. 11—Tube D, McKeesport.
Total, second half 1907: 5 furnaces, 770,000 tons annual capacity.

Summary.

	Number.	Capacity.
1905—First half	7	974,000
Second half	3	482,500
Total	10	1,456,500
1906—First half	6	825,000
Second half	4	430,000
Total	10	1,255,000
1907—First half	10	1,340,000
Second half	5	770,000
Total	15	2,110,000

As has been noted, the furnaces blown in during 1905 were furnaces which had been projected in 1902-3. The furnaces blown in during 1906, on the other hand, were, with one exception, furnaces which had just been projected, as a result of the revival in demand in 1905.

The Uncompleted Furnaces.

The blowing in of new furnaces in 1907 came to a sudden stop with the starting of Tube furnace D, at McKeesport, on Oct. 11. Had demand not fallen off, other furnaces would have been completed and blown in before the end of the year, and many more would have followed in the early part of 1908. As it is, there were 15 furnaces, with 2,110,000 tons annual capacity, blown in within a period of 9½ months, while the completion and blowing in of the furnaces under construction in October, 1907, will be strung out over a considerable period, depending on the revival in demand, just as was the case with the furnaces which were under construction when the decrease in demand came in the latter part of 1903.

The absolutely new blast furnaces under construction at the present time are as follows:

United States Steel Corporation: Duquesne Nos. 5 and 6; Gary Nos. 1, 2, 3 and 4, all authorized Oct. 10, 1906; Ohio Nos. 5 and 6; Gary Nos. 5, 6, 7 and 8, all authorized Dec. 12, 1906; total, 12 furnaces, 1,820,000 tons annual capacity.

Outside steel interests: Jones & Laughlin Steel Co., Aliquippa Nos. 1, 2, 3 and 4, which could have been completed beginning with January, 1908; Youngstown Sheet & Tube Co., Nos. 1 and 2, the first of which could have been completed about January, 1908; New York State Steel Co., No. 1, which at the beginning of 1907 was under contract to be completed before the end of that year; International Harvester Co., work on furnace begun early in 1907; Wickwire Steel Co., Buffalo, foundations completed by October, 1907; total, 9 furnaces, 1,300,000 tons annual capacity.

Merchant interests: Federal No. 2,

Chicago, contracts placed in January, 1907; Hamilton Iron & Steel Co., New River, O., ground broken in June, 1907; Cleveland No. 2, nearly completed; total, 3 furnaces, 360,000 tons annual capacity.

	Number.	Capacity.
Steel Corporation	12	1,820,000
Other steel interests	9	1,300,000
Merchant interests	3	360,000
Total under construction	24	3,480,000

With the possible exception of the second four of the Gary furnaces, all the above blast furnaces could have been completed and blown in by July 1, 1908, were the work pushed.

An Enormous Total.

This would have resulted in the completion and blowing in, in the 18 months from Jan. 1, 1907, to July 1, 1908, of no less than 35 absolutely new furnaces, with a total annual capacity of approximately 5,000,000 tons. More than two-fifths of this capacity actually did come in, during the first 10 months of the period. The blowing in of the remainder will be delayed, but if the last of the furnaces now under construction do not come in until the second half of 1909 they will not have been delayed more than were some of the furnaces upon which work was started in 1903.

The Steel Corporation's Part.

As has been noted, the furnaces blown in during 1905 represented the tail end of the new construction program adopted in 1902-3. The new furnaces completed since 1905, or partly erected, comprise the present program, with 49 stacks and 6,845,000 tons annual capacity. Never before has there been such a burst of activity in furnace erection, although there may be many more in the future.

To this total of 49 stacks and 6,845,000 tons annual capacity the United States Steel Corporation contributes 19 stacks, with 2,995,000 tons annual capacity, or 43.7 per cent of the total in point of capacity. Other steel interests contributed 17 furnaces, with 2,565,000 tons annual capacity, or 37.5 per cent, while merchant interests contribute 13 stacks with 1,285,000 tons annual capacity, or 18.8 per cent.

The Steel Corporation's contribution of 43.7 per cent to the new construction program is not unduly large, considering the circumstances. In 1905, the year preceding this movement, the Steel Corporation made 44.2 per cent of the total pig iron production of the country, so that its new construction was exactly in line with its previous position. Besides this, the Steel Corporation has been making a great deal of money, and has been carrying large coking coal and ore reserves which are represented in its capitalization; it could not, on a conservative policy, pay out much of its extra earnings in stock dividends, but should rightly extend its operations and thereby hasten the conversion of its capitalized reserves into cash. It is of relatively minor importance to the Steel Corporation that the new furnaces may not be needed immediately; it would be of little advantage, and might prove very awkward, to keep the money for a time and endeavor to spend it later, when a pressing demand might come before there was time in which to build the furnaces.

The Dependence on Lake Superior Ores.

In this total program comprising 49 new blast furnaces there are but four which are not distinctly tributary to Lake Superior ores. These four are: Burden, Troy, N. Y., to use New York concentrates; Palmerton, N. J., to make spiegeleisen from zinc residuum; Bethlehem, to use a variety of ores; Minnequa, Colorado, to use western ores, but drawing on occasion from the Lake Superior region. The south did not contribute a single absolutely new stack to this program, although of course it is doing a great deal in the way of rebuilding furnaces, and some of these operations, under a less strict rule, would be included in our summary. To the seven new furnaces blown in during the first half of 1905 the south contributed two, with 22 per cent of the total capacity.

Thus, of all the furnaces which have been blown in, or upon which erection work has been started, since Jan. 1, 1906, about 95 per cent of the capacity is absolutely dependent upon Lake Superior ores, some of the remaining 5 per cent being partially dependent. At the beginning of this article the belief was expressed that this era of new erection would be memorable through being the last period of new erection based upon Lake Superior ores. The almost absolute dependence of this crop of furnaces upon Lake Superior ores is good evidence in itself that there will not be a repetition.

The Ultimate Total Capacity.

The question naturally arises: "What will be the ultimate normal capacity of the United States for pig iron production when all these new furnaces have been completed?" This question can be answered easily, and with considerable exactness. Statistics of the actual production of the country are available for the second half of 1905 and the first half of 1907, constituting a full twelvemonth. During that period all the available capacity of the country was operated, 14 new furnaces being added at various times. Knowing the dates of blowing in of these new furnaces, and their respective capacities, and making allowances for a little poor working at the start, a close estimate can be made of how much product these new furnaces contributed. We estimate their contribution at 660,000 tons, a figure which is probably correct within 50,000 tons. The computation is as follows:

Actual make, second half, 1906	12,724,941
Actual make, first half, 1907	13,478,044
Total for twelvemonth	26,202,985
Deduct contribution of new furnaces.	660,000
Output of furnaces completed prior to July 1, 1906	25,542,985
New furnaces, July 1, 1906, to Jan. 1, 1908	2,540,000
Available capacity, Jan. 1, 1908	28,082,985
New furnaces being built	3,480,000
Ultimately available capacity	31,562,985

Summaries of blast furnace capacity as usually compiled include many obsolete or obsolescent furnaces, so that the figures of capacity are always much larger than the results attained. The above method does not thus err. On the other hand, the claim is frequently made that furnace outputs cannot be duplicated, because they were made under stress. The writer submits that if for a period of 12 months the furnaces made a certain output, there is little rational ground for a claim that they cannot repeat the performance in similar circumstances; further, that inasmuch as no account is here taken of the gradual increase in individual outputs through harder driving, through the rebuilding and otherwise improving of old furnaces, and through prospective improvements in practice, such for instance as the introduction of the Gayley dry air blast, the above estimate of 31,500,000 tons of capacity through the completion of furnaces now in course of erection is a conservative one and one which can, if necessary, be carried out in actual production.

That the time will come when the test will be made there can be no question. Demand has always, in the past, overtaken productive capacity, or there would not have been the bursts of new furnace building which have occurred. In 1909, or in some nearby year, the United States will doubtless produce well over 30,000 tons of pig iron, without the building of many, if any, additional blast furnaces.

THE MIGHTY WEST PAUSES, BUT WITH HOPE

Tremendous Prosperity Followed by Almost Complete Reversal of Conditions—New Plants Completed, Being Built and Authorized

By Oliver J. Abell.

The year 1907 did not bring to the Chicago district of the iron and steel industry any new projects of the magnificent proportions proposed in the preceding twelvemonths, but in its record of actual building operations and new capacity approaching completion may be found, from the standpoint of real growth, much noteworthy development. It is estimated that since Jan. 1, 1907, $100,000,000 has been spent in new construction at the south end of Lake Michigan alone in the erection of mills and manufacturing establishments at Gary, Indiana Harbor and the neighboring towns that have literally "sprung up" in that part of the Chicago territory. The formation also of the Minnesota Steel Co. on June 10 and the beginning of work on the steel plant at Duluth, while by no means comparable with Gary in size or importance, represent an undertaking of the Steel Corporation, similar in significance and pregnant with large possibilities. Elsewhere in the territory tributary to Chicago, both the Corporation and independent interests have completed or undertaken increases in capacity that have added to this section several blast furnaces and finishing mills. City building projects in which structural steel is the backbone of construction were fewer in number during 1907, partly for financial reasons, for it is known that plans involving nearly 70,000 tons of steel have been held up in Chicago alone. Plans were not altogether lacking, however, for individual undertakings of noteworthy size, for example the $5,000,000 plant of the Corn Products Mfg. Co., and the three depots, Union, Chicago & Northwestern and Terminal, which will require a total of fully 100,000 tons of structural material.

A brief summary of the year's construction work for the largest producers is as follows:

Illinois Steel Co., South Chicago.

COMPLETED.

Furnaces No. 1 and 2 enlarged and rebuilt.

1 30-inch universal plate mill, the first universal mill in the Chicago district and the first electrically driven reversible mill in the country. Rolls plates from 6½ to 29½ inches wide and up to 80 feet long. Capacity, 7,500 tons.

1 24-inch re-rolling rail mill to roll them 12 to 60 pound sections. Capacity 7,500 tons.

4 2,000-kilowatt gas engine-generator plants.

Illinois Steel Co., Joliet, Ill.

UNDER CONSTRUCTION.

275 Koppers by-product coke ovens. Annual capacity, 700,000 tons, which will meet the total requirements of the Joliet plant.

Indiana Steel Co., Gary, Ind.

COMPLETED.

Auxiliary shops and power plant.

UNDER CONSTRUCTION.

8 450-ton blast furnaces, four of which are nearly completed.

56 open-hearth furnaces. Annual capacity, 2,400,000 tons.

Rail mill, annual capacity, 900,000 tons. One-half completed.

Billet mill, annual capacity, 900,000 tons. One-fourth finished.

AUTHORIZED.

Universal plate mill.

160-inch sheared plate mill.

Merchant bar mills.

Minnesota Steel Co., Duluth, Minn.

PROJECTED.

2 500-ton blast furnaces.

160 by-product coke ovens. Annual capacity, 375,000 tons.

7 open-hearth furnaces. Annual capacity, 300,000 tons.

1 blooming mill.

3 finishing mills.

1 cement plant.

Inland Steel Co., Indiana Harbor, Ind.

COMPLETED.

1 400-ton blast furnace.

UNDER CONSTRUCTION.

1 Billet mill.

1 sheet bar mill.

1 merchant bar mill.

In addition to the above, two blast furnaces have been completed, one by the the Northwestern Iron Co. at Mayville, Wis., and one by the Federal Furnace Co. and another is under construction. The Calumet Steel Co. has been organized and has built machine and boiler shops and a re-rolling rail mill. The Seller's Mfg. Co. has completed a bar mill, the Iron Products Co. of Joliet has a bar mill under construction, and the Standard Steel Car Co. has completed its car building plant at Hammond, Ind.

On Jan. 1 the Wisconsin Steel Co. was organized as a subsidiary of the International Harvester Co. taking over the operation of the blast furnaces and bar mill. To the original plant have been added a merchant bar mill of 7,500 tons capacity which was finished in May, 1907, a blast furnace now under construction and to be completed about Feb. 15, 1907, a Brown Hoist conveying and ore unloading plant, pattern storage and ladle repairing buildings and 35 acres of land.

Labor Troubles.

Labor disturbances throughout the year have been general rather than severe or localized and have arisen almost entirely over questions of increased wages. The high prices obtained for every line of products has been an incentive to the machinists, boilermakers, structural iron workers and foundry workers to demand increased wage minimums and higher individual remuneration. Among mill men agreements have been made on new scales and a general avoidance of trouble resulted. For the most part, the demands of the men were acceded to and in the first part of the year wages of employes were increased 11 per cent. The year therefore, has been without any serious tie-ups.

The Pig Iron Market.

From the standpoint of production, furnaces and mills alike pursued a parallel course throughout the year, but the pig iron market was affected differently than were operations in crude and finished material from the iron and steel mills. The last quarter of 1906 and the first months of 1907 saw a tremendous buying movement in pig iron in which nearly all of the furnaces, both north and south, sold up to their capacity for the first six months and for the last six months to an unprecedented extent. As a result the year opened with prices at a remarkably high level, northern No. 2 foundry commanding as much as $30 and southern No. 2 selling above $29.50. The requirements of consumers also were well filled. Trading, therefore, was desultory and uncertain and inquiry for further tonnage was very light, except for temporary periods of firmness under such

circumstances as the flood in Pittsburg which caused the banking of so many stacks. In June came the first recession in the price of spot pig iron that had occurred in a year and for each month succeeding there was an approximate reduction of $1 per ton until November and December, when the price fell off $4 in 60 days. This was true both of northern and southern iron and the year's closing prices were on the basis of $13.50 Birmingham and $17.50 for northern iron.

All during this time up to Nov. 1, furnaces were operating at maximum capacity, each month bringing new records and October witnessing the record production for the year. Melters had been taking their iron eagerly and consuming it rapidly. In September the definite curtailment of consumption became evident followed in November by an unprecedented reduction in output, so decisive that on the first of December it was conservatively estimated that fully 60 per cent of the productive capacity had been affected. In contrast to the spread between iron for prompt and future delivery in the first eight months of the year, which placed spot iron at a premium, the last months of the year found spot iron selling at prices that would not be considered for first half delivery in 1908. Through out the last quarter, the absence of buying for the following year was very marked and the quantity of iron that was carried over into 1908 by the extension of deliveries in this district is almost enough to supply consumers for the first quarter on the present scale of operations.

While those who continued their contracts through the last quarter were paying the highest prices of the year on iron, the largest purchase of the last half was made at practically the lowest prices from the furnace. It comprised an aggregate of 25,000 tons made up of No. 1 and No. 2 grades, silicon content averaging about 2.50 per cent and it was sold by a northern furnace interest at a price corresponding to less than $14 Birmingham basis.

Finished Materials.

In mill products the situation was identical with that of pig iron as regards the filled up condition of the mill capacity, but in contrast, the price and market status of billets, plates, structural stee' steel bars, sheets, wire products and tubular goods were clearly established and maintained practically to the end of the year. Prices of sheets and bar iron weakened with the falling off in buying in the last quarter. During the first eight months, premiums were paid for anything like prompt delivery on plates, bars, sheets, merchant pipe and boiler tubes and through half of that time prices advanced continually as is indicated in the accompanying table of average monthly prices.

The Illinois Steel Co. began the year with its 1907 rail tonnage sold up—approximately 650,000 tons—and was diverting tonnage to eastern mills; its plate mill capacity likewise was completely filled and during the year enough additional orders were taken to carry over until July, 1908. The American Car & Foundry Co. was reported sold up in April with orders for 80,000 cars and at the same time the American Steel & Wire Co. had four times as much business as in 1906 and sales were 1,000 tons a day heavier. At the end of March the highest level of orders and specifications ever reached for mill products existed and it was reported that on the books of the principal producer were specifications aggregating 495,000 tons against orders amounting to 1,250,000 tons and in the same week the American Bridge Co. secured orders for 125,000 tons of structural material, making it the biggest week's business in the history of the Chicago office.

With mills in such shape, the question of deliveries assumed a serious aspect. Railroads were utterly unable to cope with the situation and were complicating it with rate increases, and congestion in mill yards was rapidly augmented. Four to six months was the best that could be done on plates, 20 to 26 weeks on sheets, two months on structural shapes, three months on light rails, six months on heavy rails, two to four months on steel bars, six weeks to two months on iron bars and three months on merchant pipe with better deliveries than those commanding premiums running from $2 to $6 per ton.

Curtailment of Production.

More interesting however than prices of finished products was the remarkable change in the rate of production, for the year ended with order books burdened with cancellations and extensions, mills running from hand to mouth, prompt deliveries readily obtained, railroads out of the market, consumers in need of material yet fearful or unable to buy and producers seeking of necessity new avenues of retrenchment. The principal producer, however, was well filled up to the end of the year on rails and plates and the American Bridge Co. carried over into 1908, 50,000 tons of unfilled orders in this district alone. Aside from these instances, both plates and shapes could be obtained promptly in Chicago Bar. mills, both iron and steel, became practically idle in December, wire mills of the leading interest had orders sufficient for 30 days running and pipes and tubes were being rolled for stock.

To appreciate this change in the activity of productive forces, all in the course of three months, is to give to it foremost place in the notable events of the industrial year. Despite its suddenness, signs of its coming were not lacking. The dullness and uncertainty in pig iron after the first quarter,

Average Monthly Prices, Chicago Delivery.

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Northern No. 2 Foundry	$26.00	$26.50	$26.75	$27.50	$27.40	$26.50	$25.37	$24.50	$23.625	$22.60	$20.62	$18.25
Southern No. 2 Foundry	$26.97	$27.10	$26.35	$26.85	$26.95	$26.60	$25.75	$24.35	$23.25	$22.85	$20.47	$18.47
Malleable Bessemer	$25.90	$25.625	$25.50	$26.25	$26.90	$27.00	$25.00	$24.80	$23.25	$23.00	$22.25	$19.50
Lake Superior Charcoal	$25.50	$26.75	$25.50	$26.00	$27.10	$27.37	$27.10	$27.00	$26.75	$26.10	$25.25	$23.50
Forging Billets	$38.40	$37.00	$36.00	$36.50	$36.00	$36.00	$36.50	$36.00	$35.75	$35.60	$33.50	$33.00
Bar Iron	1.795c	1.79c	1.815c	1.815c	1.77c	1.78c	1.78c	1.75c	1.78c	1.78c	1.765c	1.765c
Steel Bars	1.765c	1.765c	1.765c	1.765c	1.77c	1.78c	1.78c	1.78c	1.78c	1.78c	1.78c	1.78c
Small Steel Angles (less than 3 x 3 inches)	1.865c	1.865c	1.865c	1.865c	1.87c	1.88c	1.88c	1.88c	1.88c	1.88c	1.88c	1.88c
Black Sheets No. 28	2.765c	2.765c	2.765c	2.765c	2.77c	2.78c	2.78c	2.78c	2.78c	2.78c	2.78c	2.78c
Structural Steel	1.865c	1.865c	1.865c	1.865c	1.97c	1.98c	1.98c	1.98c	1.88c	1.88c	1.88c	1.88c
Plates	1.765c	1.865c	1.865c	1.865c	1.87c	1.88c	1.88c	1.88c	1.88c	1.88c	1.88c	1.88c
Smooth Finished Machinery Steel	2.015c	2.1275c	2.165c	2.165c	2.17c	2.18c	2.18c	2.18c	2.18c	2.18c	2.18c	2.18c
Wire Nails	$ 2.15	$ 2.15	$ 2.15	$ 2.15	$ 2.15	$ 2.18	$ 2.18	$ 2.18	$ 2.28	$ 2.23	$ 2.23	$ 2.23
Car Wheels	$24.75	$23.56	$23.875	$25.00	$25.05	$25.00	$23.66	$24.50	$24.50	$24.50	$21.75	$19.25
Old Iron Rails	$26.90	$25.25	$25.00	$24.375	$24.50	$24.25	$22.75	$21.40	$20.90	$19.75	$17.00	$15.50

Above prices are strictly mill and furnace prices.

covered up though it was by the tremendous furnace production, prophesies such as that of J. J. Hill in February regarding railroad curtailments, the heavy loan movement by the railroads early in the year, the shake-up in eastern financial circles a few weeks later, when 2,719,000 shares were sold in a day and prices dropped as much as 20 points, the slow contracting by the railroads for 1908 rail tonnage in May when only 50,000 tons was contracted for as compared with an entire year's requirements in May, 1906, the great overproduction of copper no longer possible of concealment, midsummer evidences of retrenchment in the matter of car building contracts and recurring periods of severe though short lived financial stress—all pointed, in the light of later developments, to the conditions we now have existing.

As the object of an economic study of our industrial and financial methods and affairs, the past year presents a succession of events of surpassing interest. A study it is also, in which the great western territory centering about Chicago may find at least one fact of more than passing import. The west has stood during the years of its prosperity, confident of the independence of its enormous agricultural, manufacturing and mineral wealth, confident of the isolation of its public weal from the influences of eastern manipulation. The west still believes in the latent and indestructible strength of its resources and well it may. Nevertheless, the carnival of conditions which in January began with a bounding spirit of prosperity, leashed only by its physical inability to expand indefinitely, has now become, almost as if in the passing of a night, a slowly moving procession, inert, suspicious, broken in rank and lacking in courage. Its greatest hope is in the day just ahead, a hope that it will break bright and clear, and yet—the sun rises in the east. In short, the year 1907 has taught the merchant, the producer and the workman that industrial conditions are dominated by financial conditions and the seat of finance is not in the west.

RADICAL CHANGES IN THE EASTERN MARKET

Period of Great Prosperity Followed by Months of Stagnation, Failures, and Low Prices—More Attention Given Eastern and Cuban Ore Deposits

By B. S. Stephenson.

To review the iron and steel situation of the year just closed is to tell a story of mighty contrasts; of seemingly boundless prosperity and of a series of surprising failures; of record prices and of hard-driven sales below production cost; of unequalled output and of the sharpest curtailment in the industry's history; of a demand so insistent as to attract heavy importations and of a market thoroughly stagnant.

The first quarter of the year, roughly speaking, was active in the extreme, with little to indicate that a day of reckoning was at hand. The final quarter saw the country's industries at low ebb, with only sentimental indications of an early improvement. The months between formed a readjustment period, a time of hesitancy and doubt, with discouraging developments on every hand.

The Trend of Pig Iron.

The beginning of 1907 found the eastern pig iron market vigorous and healthy. Sales of good tonnage were frequent at $22.50 to $24.50, furnace, for No. 2X, spot metal commanding a considerable premium. Practically every stack capable of operation was being pushed to capacity and no stocks were being accumulated. Producers were finding a ready market at figures yielding a handsome profit. By the early part of February, however, a slackening in demand was noticeable. Shipments were going ahead promptly, there was no accumulation of iron and there was no talk of lowering prices, but selling became of more moderate nature, the situation steadily assuming a more quiet tone. The failure of Milliken Bros., Inc., early in June was disastrous not alone for its sentimental effect, as it released for re-selling a heavy tonnage of iron contracted for second half delivery. Prices were fairly well maintained, in spite of these discouraging features, until about midsummer, when shading for any delivery set in. Lower prices on spot iron had been the rule for some two months before. Then, with the beginning of fall, the breaking of the financial storm and its attendant evils brought with it a speedy and heavy curtailment in production, a feature with which the trade has not been brought face to face earlier in the year. August witnessed the most extensive decline of the season, in some lines this being as much as $3.00 during the month, and the remainder of the year was marked by a further, though more moderate, decline. The determined stand of producers to restrict their output to meet the lessened demand had its effect in preventing panicky conditions in the industry during these months, however, and the blowing out of numerous eastern stacks late in October and throughout November—reducing production to about 50 per cent of the normal capacity—instilled strength into the situation to such a degree that the closing weeks of the year saw a considerable improvement, both in actual and prospective business.

Iron Import Movement.

During the first half of the year under review, the high prices of domestic iron and the difficulty of securing spot metal led to the engaging of a heavy tonnage of British iron ore for shipment to this country. This was purchased at a price which, with approximately $6.00 added for duty, freight, insurance, etc., allowed it to be put down at seaboard considerably below the price of home-made iron, and the movement continued as long as demand and prices were favorable. There were two well-defined periods of importation, the last ending in May or early June, though cargoes already contracted for continued to arrive up to Sept. 1. This foreign iron was mostly consumed near the seaboard, though some found its way as far west as Pittsburg and in occasional instances somewhat farther. An interesting, though not important, development of the early part of the year was the receipt of a large cargo of Chinese basic, which found a ready sale. A later cargo, however, was disposed of with difficulty.

New Pig Iron Capacity.

There have been few additions during the year to the blast furnace capacity of New York and other eastern states. The Lackawanna Steel Co.

blew in its new stack, No. 7, on Feb. 12. The New York State Steel Co., also at Buffalo, has its blast furnaces near completion. The failure of Milliken Bros., Inc., and the decision of the receivers to operate only the structural shop put an end, for the present, at least, to the reported prospect of the erection of blast furnaces in connection with the Staten Island plant. The formation of the Susquehanna Iron Co. brought two idle stacks into strong financial control, but the restoration of these to the active list was rendered impossible by the weak conditions of the fall. The Bethlehem Steel Co. blew in its stack E on April 15.

Eastern Iron Ore Supply.

The increasing cost of Lake Superior ores has had the effect of directing more careful attention to eastern deposits, with the result that in New Jersey, Eastern Pennsylvania and New York a number of mines have resumed operations, in some cases after long stretches of inactivity. There has also been increasing interest in concentrating and briquetting the ore, licenses having been issued to both the Pennsylvania Steel Co. and the Berkshire Iron Works for operation under the Grondal concentrating patents to the limit of 150,000 tons annually each. The most important development in the eastern ore situation, however, has been, of course, the discovery of the immense deposits on the northeast coast of Cuba and the measures taken by the Pennsylvania Steel interests with a view to working them. From this remarkable Bessemer deposit, estimated to contain over 500,000,000 tons, the Spanish-American Iron Co. will mine and ship not less than 1,000,000 tons annually. The extensive development of these properties is certain to exert a lasting effect in furthering the advance of the steel industry on the Atlantic coast.

Steel and Finishing Capacity.

Several notable additions to the steel-making capacity of the eastern district have become operative during the year. At Buffalo the New York State Steel Co. in April lighted the fires in its two large Talbot open-hearth furnaces, turning the output into billets, blooms and slabs. During the financial difficulties of the fall this company went into the hands of a receiver, but plans are now making for raising the receivership. The Pennsylvania Steel Co. at its Steelton works completed ahead of schedule the construction of its new open-hearth plant, consisting of five 75-ton furnaces, these becoming operative before the middle of the year. At the same plant 120 by-product coke ovens were started in January. At Bethlehem, Pa., the Bethlehem Steel Co. late in October started its new 28-inch rail mill, the first unit of the $12,000,000 Saucon plant begun over a year ago. This plant includes ten 50-ton basic open-hearth furnaces, the rail mill, a structural mill and the Grey universal beam mill, all of which were described in THE IRON TRADE REVIEW of Nov. 7. The structural mill will be placed in operation early in the new year.

As a partial offset to this increase in steel-making capacity, there has been a loss through the closing of the open-hearth department of the Milliken plant, following the appointment of receivers, and the adoption of a similar program by the officials of the Passaic Steel Co., both plants now confining their activities to the operation of their bridge and structural shops.

The formation of the Susquehanna Iron Co. has resulted in the placing in the active list of considerable bar iron, skelp and pipe capacity. New open-hearth steel foundry capacity has become operative at Newark, N. J., through the completion of the plant of the Atha Steel Casting Co., and at Chester, Pa., where the Federal Steel Casting Co. has a 25-ton furnace. At Buffalo the E. G. Rippel Steel Foundry has completed three crucible oil furnaces and at Chester, Pa., the Keystone Steel Casting Co. has started both its crucible steel and McHaffie steel plants.

Market for Finished Products.

In point of tonnage consumed, the year has been a remarkable one in structural steel lines, October establishing a new record for work turned out by the American Bridge Co., while independent interests have been extremely busy. The demand apparently was general throughout the country, though New York has been an unusually heavy consumer by reason of extensive office building construction and of the improvement of dock and transportation facilities. So far, however, as the booking of new orders is concerned, the second half of the year has been extremely quiet. Financial conditions have been such that few new building operations have been undertaken and even New York City, hard pressed by a multitude of demands, has curtailed its work to the minimum. Likewise, railway improvements have been largely discontinued and replacement and repair work has been carried out only where absolutely necessary. In the marine field, little construction work has been undertaken and many of the smaller yards are practically idle.

The result of this curtailment program has been a vigorous campaign to secure whatever business might be current. The premiums for quick shipment, a feature of the early months of the year, have disappeared and there has been the keenest of competition among contractors. Remarkably low figures have been made on construction jobs recently let.

Prices Well Maintained.

A comparison of prices current at the opening of the year with those prevailing at the close shows important changes only in bar iron. In fact, a table of prices holding throughout the year makes it plain that despite the fact of a steadily lessening demand fluctuations have not been material. The industry has learned that new business cannot be created by wholesale price-cutting. With the exception that premium business has been wiped out, angles, channels, beams, sheets and steel bars are on the same level as 12 months ago. Bar iron opened the year at 1.85c, Pittsburg base, and has dropped to 1.60c, where it is now being well maintained. Plates have held unchanged at 1.70c, Pittsburg base, but eastern mills, which make a practice in vigorous times of catering to quick delivery business, have felt the effect of the decreased demand which has removed the possibility of premium prices.

In cast iron pipe, the financial disorders have resulted in reducing new business to a minimum. Railway interests have bought only moderately and municipalities, from which the bulk of orders come, have met with such difficulty in disposing of their low interest securities that many projected undertakings have of necessity been postponed or abandoned. Some attractive foreign business has been taken during the fall.

Some New Developments.

Of foremost importance in the developments of the year has been the acquisition by the United States Steel Corporation of the outstanding stock of the Tennessee Coal, Iron & Railroad Co., the details of this transaction having played an extensive part in the clearing of the recent financial storm. This brings to the Corporation immense additional resources in the way of southern iron, coal and timber lands, as well as a well-organized steel concern which will add about 2½ per cent to its steel-making capacity. The Corporation also early in the fall acquired the New Haven plant of the National Steel & Wire Co. by purchase at trustees' sale.

Failures of the year have been

UPS AND DOWNS OF THE BRITISH IRON MARKET

Some Conditions Resembled Those in the United States---High Cost of Coal Troubled the Iron Makers---Heavy Dividends Paid.

BY J. HORTON.

The year 1907 in the British iron trade will be remembered as a year of paradoxes, inconsistencies, and falsified prophecies. The trade has had a most disconcerting way of doing the unexpected thing at the unexpected time. The close of the year finds it still as paradoxical as ever. Makers and dealers alike agree that, to quote their own phrase, "They have never known anything like it."

One of the unexpected features has been a further revival of puddling, which most people believed to be on its last legs, and the erection or recommencement of puddling furnaces, with a decided reaction in favor of iron as compared with steel. The close of the year finds some reversion of this movement, owing to the cheaper rates for semi-raw steel. The most curious paradox has been the scramble for pig iron, associated as it has been with falling markets, and especially with an unprecedented inroad upon the Cleveland stocks. More than half a million tons have gone out of store during the year, and the reduction still continues, although furnaces are closing down in all directions. For years, bars were the weak feature of the market, but the conspicuous element of the year's trade has been a regular demand for bar iron, second only to that for galvanized sheets. Three months ago there was a general and confident prediction that Cleveland prices would hover in the neighborhood of 60 shillings to the end of the year, but this estimate has been found quite half a sovereign too high, and some of the knowing ones have accordingly been rather badly hit in consequence.

The Spring Boom.

The boom period came in May, when in one week withdrawals from the Cleveland stores eclipsed all records, and prices mounted 5 shillings in a couple of weeks. It is now agreed that the American demand for pig iron has all along introduced an element of inflation which has not been good for the trade, and which has undoubtedly narrowed down the profits of British manufacturers by compelling them to pay more than the real market value for their pig iron. Except in rare instances, this extra cost has never been obtained from the consumer. It was in the month of May that the highest prices were realized for steel sheet bars, of which large quantities were bought at £6 5s to £6 7s 6d. At this time Northamptonshire pig iron made £3 1s per ton, and North Staffordshire £3 3s.

Ship Building Helped.

The activity in ship building was largely responsible for the big demand of the spring, and in this line former records were fairly beaten. The northern iron trade was assisted by some big orders for rails from the leading railway companies, which also at that period gave out a lot of work to the wagon companies. The April quarterly meeting was undoubtedly the best of the year. This was the high water mark of pig iron shipments, the exports exceeding those of the corresponding three months of the previous year by nearly 125,000 tons. Of the export total Italy took 27,000 tons, Germany 77,000, and the United States 88,000. Enormous orders were also received at this period for galvanized sheets, from South America, South Africa, and Japan, while Australia was a very good buyer. The activity of ship building had its effect upon the Birmingham metal trades engaged in various branches of ship building equipment, and the same cause kept the chain and spike trades of Dudley very busy with a large consumption of small bars and wire. On the whole, wire has had a good year, but is now experiencing the quietude from which every other branch is suffering.

New Sheet Records.

While galvanized sheet output has been, month after month, making new records, profits are quite another story, and have, generally speaking, been narrow and unsatisfactory, on account of dear material. Spelter has all along been a great trouble, and makers of steel sheets have been terribly handicapped by the high price of bars, which have gone up in price quite out of proportion to the rise in the finished product. The entire absence of imported steel left the makers quite at the mercy of the great steel producing houses, which, for a time, must have coined money. The steel makers lost no opportunity of making hay while the sun shone, and their agreement as to prices extracted the last farthing from the consumer. But Nemesis has now overtaken them, steel being a drug in the market, while the high prices and the peculiar arrangement affecting the different districts, already described in THE IRON TRADE REVIEW by which Londoners get their steel exactly at the same price as Birmingham men inflicted a terrible blow upon constructional engineering in the Midlands. The pig iron smelter has exactly the same melancholy story to tell in regard to dear materials as the maker of galvanized sheets, and owing to dear coke, mineral, and ironstone, he declares that profits are more and more shadowy. This is, in fact, the explanation why, in so many cases, blast furnaces are being shut down.

Good Foundry Trade.

Probably the foundry trade has never had a better year. This industry has had stimulating causes of its own. The long depression left forges poorly equipped with rolls, housings, and engine power, so that purchases for mills and engine renewals have been practically constant. The activity in tin plates, too, has brought a great demand for hard and soft rolls, of which the Birmingham district has been the great feeder of the foundry order book. The great demand for electrical plant, suction gas engines, tramways, joints and points, for municipal tramways, the increasing use of machinery in most industries especially the brass trade, and the substitution of steel sheets, cogs, pinions, etc., have all found work for the foundry. This has kept up the price of foundry iron at an abnormal figure throughout the year. Certainly, this branch has better prospects for the new year than any branch of the wrought iron and steel trades.

High Cost of Coal.

There seems to have been a kind of conspiracy to fleece iron manufacturers. Dear coal has been a constant trouble, and the December dullness of the iron trade coincides with yet one more demand by the colliers for higher wages, which may possibly succeed. A kind of last straw to the overburdened camel has been the ac-

tion of the railway companies in altering their carrying arrangements. Formerly they allowed 20½ hundredweight to the ton, but in June they made this a fixed 20 hundred-weight. The effect of this was to add about 2½ per cent to the cost of carriage, but wrought much more mischief in necessitating a number of rearrangements as between collieries, coal merchants, and their customers.

In regard to the coal trade it is remarkable that, although we are in the winter month, coal is distinctly weaker than it was in August. This is partly due to the extent to which householders, contrary to their usual custom, laid in their winter stocks in midsummer.

The greatest vicissitudes have been experienced by the makers of steel billets. In February last, billets were so scarce that some makers of steel sheets had to refuse orders, through the sheer impossibility of getting material even at the high price then prevailing. This state of things has completely passed away and there is no knowing where billets will arrive before the present slump comes to an end.

Higher Bank Rate.

The greatest blow the trade has received has been the increase in the bank rate to 7 per cent, which has shut off large quantities of railway orders, has entirely arrested engineering enterprises, and has discouraged municipalities from giving out the new work which it was understood they were contemplating some time ago. For this increase, there is a disposition to blame America, and in support of this view makers point to the fact that until the disastrous increases of the bank rate, following quickly one upon another, there was quite enough new business to keep the mills in full work. The fall in the rate in January last had a most encouraging effect upon the trade, and led optimists to predict a long course of prosperity. The high standard has now practically stopped the operations of everybody whose position is at all financially weak, and dependent on borrowed capital.

On the whole, prices have been very steady during the year. The averages for March and April, as shown by the return of the Midland Wages Board, gave a selling price of £7 7s 0d. 75; for May and June, £7 7s 6d.27; for July and August, £7 8s 6d.92; for September and October, the latest return to hand, £7 10s 6d.93.

Wage Questions.

The relation between the Midland Wages Board and the North of England has imposed a severe strain upon the loyalty of the Midland men, as, for the whole of the year, the latter district has failed to secure such wages as would give them 6d more per ton over the northern rate for puddling in lieu of northern extras. At the present time, they are short of this amount by 3d per ton and there seems no probability that they will secure it. In the old days this would have involved an inevitable strike to secure the balance, but the men are now content to quietly bide their time until the first experimental period of the new sliding scale expires next year, when they will alter the premium. It is to the credit of the men, no less than the employers, that strikes are practically unknown in the iron trade. Daniel Jones, the employers' secretary, recently called attention to the fact that for two generations there has not been a strike in any works connected with the board, and for 10 years past it has not been necessary to appeal to the umpire to settle any disputes. In a recent speech Mr. Cox, the men's secretary, called attention to returns issued by the board of trade relating to strikes and lockouts, which showed a loss of 3,000,000 days' work over last year. On this Mr. Cox remarked: "Not a single day of those 3,000,000 days' loss of work could be attributed to any action of this society, or have taken place in any of our works. On the other hand, we have faced many difficulties relating to work and wages, we have settled many disputes throughout the country, and have carried out the policy of reason and peace by principles of conciliation and arbitration."

Good Year For Tin Plate.

The tin plate trade has had a fairly good year with prices above the average. The mills have been working regularly, and the export trade has been good. Although a good deal of the American trade has now been lost, this has been replaced by dealing with other markets. A feature of the year has been the amalgamation between steel houses and tin plate manufacturers. The latest of the kind is the action of Baldwins Ltd., a great concern capitalized at over a million and purchasing, or securing a controling interest in the Beaufort Tin Plate Works, Morriston, purchased nearly three years ago for £10,000 by T. J. Williams. The works are among the best situated in the Swansea district, and are close to Baldwin's steel works at Landor. They comprise nine mills employing 400 hands.

Large Dividends.

A special feature of the year has been the improving dividends among iron and steel companies. In some cases, the profits have been very large, and of these some details have previously been given. But the largest works have taken the precaution to build up substantial reserves, in the expectation of the German and Belgian competition which has all along been predicted as certain to come when high tide was reached. This foreign metal is coming in increasing quantities, and the reserves will probably be wanted to help in paying next year's dividends.

The gloomiest anticipations are entertained with regard to the new year, because it is believed that present orders will be worked out by the end of the year, and that there will then be a general scramble for orders at prices materially below those now being obtained.

The hematite trade has been the most severely hit by the slump, a large number of furnaces having been blown out on the east coast. For ordinary iron very few have had to cease production, and all the iron made has gone into consumption; this has not, however, prevented a most serious falling off in price.

REMINGTON TYPEWRITER BONUS.

The 10th half-yearly bonus payment at the Remington Typewriter factory of Wyckoff, Seamans & Benedict, Ilion, N. Y., took place Dec. 24. More than $130,000 has now been distributed in this way to the most efficient of the employes who have been able to retain their positions for 10 years and more. In the factory hall on this occasion $13,800 in gold was distributed among 276 selected workmen, including two 30-year, 13 25-year, 40 20-year, 84 15-year and 137 10-year men. The certificates and prizes for good suggestions adopted during the last six months were awarded at the same time.

Buys Engine Business.—The Foos Gas Engine Co., Springfield, O., has purchased the business of the Marinette Gas Engine Co., Chicago Heights, Ill., which comprises the line of Walrath multiple cylinder engines for electric and power work, from 20 to 500 horsepower. This engine has been on the market for over 10 years. This complete line of vertical engines with the line of horizontal engines from 2 to 90 horsepower with their various equipments, which have been on the market for 20 years, makes the Foos

A YEAR'S PROGRESS IN LABOR'S FIELD

Steady Advance of the Open Shop Principle---Important Decisions of the Courts--Improvement in Public Opinion.

By James A. Emery.[1]

The columns of this number present to its readers a story of a year's progress in the development and extension of the iron and steel industries which staggers the mind to contemplate. The statistics of growth are easily condensed, rapidly enumerated, they flow glibly from the tongue, but a realization of the tremendous significance, of the network of protean activity in mining, manufacturing, transportation and commerce which they connote, seems beyond coherent imagination. The manufacturing activities dependent upon the rough ore of our iron mines represent not merely the chief manufacturing industries of America, but, relatively speaking, of the world. Yet all this tremendous movement is dependent for its maintenance and perpetuity upon the coordination of guiding minds controling and directing the skill and energy of thousands of subordinate heads and hands. They alone make possible the miraculous transformation of the crude gift of mother earth into the necessities, conveniences and luxuries that support and insure our material progress and have become the very security of civilization itself. Therefore the questions that arise from the relationship of supervising and directing skill to the operatives of this gigantic industry, as they may halt or hurry all its progress, require first consideration; and, tremendous as they are, express but a phase of the world-wide problem of permanently adjusting, upon terms of morality, justice and sound economics, not merely the relations of employer and employe, but of these two to the great public which is ultimately their greatest beneficiary as it is the ultimate source of their entire support.

Wage Wars.

No need to rehearse the history of economic differences between wage payer and wage receiver that have inconvenienced, disturbed, at times demoralized, and on occasion even threatened the destruction of great branches of the iron mining and iron making of our nation. The struggle of organized labor to secure a dominant control in the extraction of the ore and every process of its use even into the higher forms of steel manufacture are familiar history to the leaders as well as followers of your industry. It is therefore a matter no less of interest than of congratulation that the close of this year seems to mark the conclusion of perhaps the last great struggle for ecomonic freedom of employer and of employe in a great branch of your industry—the one to direct, supervise and control his plant, the other to learn his trade and teach it to his children, accepting the hours, wages and conditions of employment that suit him best, and to remain in the uninterrupted use and disposition of the fruit of such property as rewards the degree of his trade skill. From the steel makers who made civil war at Homestead to the iron molders who have retreated in demoralized discomfiture before the firm but fair leadership of the National Founders' Association, has been a considerable step in time, but the demands which forced both struggles were practically the same and the means employed to compel their acceptance differed only in degree, not in kind.

The great contest forced upon the organized foundries of the United States by the Molders' Union to compel the equal reward of unequal service, the continued acceptance of a restriction both of production and of producers, and the closed shop, would, if successful, have placed the great foundries of the country under the complete and despotic control of a labor trust as perfect in its organization and as complete in its monoply as any corporation that ever succeeded in restraining commerce and compelling trade by artificial and illegal combination.

Opening of Opportunity.

The conclusion of this great struggle during the present year has not only meant, in the completeness of its victory, a probably permanent security for many years under vigilant leadership, but the opening of industrial opportunity to thousands of young men to whom the gateways of the foundry trades have been closed. It means more—the revelations which have come to experienced foundrymen in their first contact with radical labor saving devices in their own industry, the astounding discovery of the incompetent workmanship and restricted production to which many had unconsciously submitted, should mean not merely a great saving in future costs of production, but a steady and assured gain in both its quantity and quality. Above all, it should arouse the leaders of a great industry to an increased appreciation of the value of the moral factors in production, of the necessity of being both firm and fair in their industrial relations, of sticking to principle, not only because it is right but because it pays.

Not merely your industry but all industry rests ultimately upon fixed laws of action, with principles no less certain in their application than the great law that brought Newton's apple to the earth and holds the swinging lamps of the night in their secure relation each to the other. Yet it has frequently been that the same man who would detect and instantly correct a 10-cent waste in his office remained the knowing but inactive victim of thousand dollar wastes in his foundry, and submitted in conscious cowardice or unconscious stupidity to the resistless but certain domination of himself by his operatives, becoming another unit in the chain of moral agents who suffered not merely the creation of conditions that meant ultimate material loss to himself and injury to his industry but the corruption of those principles of the republic upon which all successful business is predicated.

The Open Foundry.

The victory for an open foundry door comes at a moment of general advance all along the line. It may be safely said today that, comparatively speaking, the instruments of transportation by rail are made in open shops, move over rails manufactured under similar conditions, guided and directed by human agents who, protecting their working conditions, recognize the equal right of every other worker to accept or reject their organization. Indeed, during the year, lithography, telegraphy, the printing industry, and great centers of manufacture, have moved securely toward a basis of free labor, while construction, the stronghold of the labor monopoly, in several of its greatest centers, notably New York, Washington, Boston, Detroit, St. Louis, Cleveland, Louisville and

[1]Secretary Citizens' Industrial Association of America.

numberless smaller cities of the middle west and south, is more largely than ever on an open shop basis.

Nor has this change been accompanied either by a decrease of wages or an increase of hours, but, on the contrary, attracting to employment, under the guarantee of rewarded merit, the skilled workman who relies upon his own efficiency and not that of his organization, it has found the American employer, generally speaking, not only willing but anxious to pay the highest wage for the highest efficiency. Indeed, the advancing movement of the open shop finds its promise to the worker fulfilled and the prophets of closed shop unionism rebuked, repudiated and refuted by the investigators of the Department of Commerce and Labor for 1906, who disclosed, generally speaking, increased wages based upon unrestricted production and stimulated individual efficiency, the increased costs of living, accompanied throughout the country by a general voluntarily increased wage, exceeding in comparison the increased costs and giving an increased purchasing power to each dollar of the increased wage.

Even at the present moment, as we pass through a period of financial depression that has bordered dangerously on a panic, there seems little reason to believe that the value of efficient labor will suffer any real depreciation. Watered labor, like watered stock, whose value has been sustained by manipulation or combination, will naturally suffer in the closer competition that may be caused by shorter extensions of credit and the general tightness of the money market, but there is even now evidently no injury to the real producers of wealth, the curtailment of what may be termed speculative production cannot yet be called permanent, and is largely the outgrowth of prudence watching its next year's market, with a clear and careful eye upon present conditions.

Attitude of the Courts.

The general practical advance of the free labor movement in the past year is assured of its grand successes by the continuous success in obtaining judicial interpretation of industrial rights and by the downing of some of those political ghosts which have so long carried fright to the politician. The effort to unionize by legislation where the cruder and rougher weapons of the boycott and the strike accompanied by violence, have failed, has received continuous checks, not merely in congress but in the legislatures of various states.

But, finally, the greatest security for the defense of the open shop is found in the continuous improvement of public opinion on labor questions. The violence in accompaniment of labor disturbances which a few years ago was so frequently tolerated, condoned and even defended, has found in the past year little or no popular support. Portions of the press, which a short time ago hesitated to criticize the wrongful acts of labor leaders, have vigorously condemned the dangerous economic and socialistic tendencies in modern unionism and have declined, like Secretary Taft, to recognize "a favored class of wrongdoers among workmen." The press of our day, largely speaking, is more a follower than a leader, a reflector of public opinion rather than a maker of it, except in so far as mere forms of journalism by perversion of facts upon which public judgment is formed have succeeded in discoloring the popular conclusions. The Citizens' Industrial Association of America has made it its special effort to diffuse correct information concerning the acts, tendencies and purposes of organizations of industry that do not square with its peaceful success and orderly development, that threaten injury by their practices to employer and employe, and would undermine the foundation of civic and moral principle upon which the superstructure of industrial and commercial prosperity is reared and sustained. Through every legitimate medium by which the public may be reached and aroused and its judgment formed and maintained, the association has exercised itself, and where a year ago with moderate success it found consideration at the hands of a single periodical or newspaper, its ideas and principles are today received, approved and commented upon by a dozen mediums of public information, and it is here that the ultimate bulwark must be formed. Men cannot act right until they think right. Their industrial practices are predicated upon their industrial judgment. No movement, consciously or unconsciously, in contradiction with the principles of our government can long receive public support if its purposes and tendencies are once understood. Its success depends upon its ability to deceive or misrepresent, in the publicity that illuminates its real ends, and the means by which they are obtained is to be found a permanent and ultimate prevention of their growth. To this task our association is dedicated and to this effort the past year has afforded unusual and consistent encouragement.

AMONG NEW ENGLAND INDUSTRIES.

(Special Correspondence.)

Worcester, Mass., Dec. 30.—It appears there is good prospects of selling the property of the Berkshire Motor Car Co. for enough to cover all liabilities. The company is now in the hands of temporary receivers. The plant is located at Pittsfield, Mass.

Well authenticated reports indicate the approaching removal of the Remington Arms Co., from Ilion, N. Y., to Bridgeport, Conn., the purpose being to bring near together the manufacturing plants of the Remington Arms Co., the Hartley Co. and the Union Metallic Cartridge Co. The Remington Arms Co. employs about 2,000 hands.

There is prospects or a reorganization of the Electric Vehicle Co., Hartford, now in the hands of receivers. The intention is to raise new capital to provide sufficient working funds for putting the concern in a strong financial position. The bondholders will not attempt foreclosure, being convinced their interests will be better served to permit the proposed reorganization to go into effect.

The Union Metallic Cartridge Co., Bridgeport, Conn., has acquired a tract of land adjoining its plant. This is to provide facilities for future expansion.

It is reported the United States Steel Corporation is planning to largely increase the facilities of its recently acquired plant in Fair Haven, formerly owned by the National Steel & Wire Co. to be used principally as a wire and strap steel works.

Reports from various sections of New England indicate an increased number of shops curtailing working hours, while a number that had suspended entirely have resumed work on shorter hours. A majority continue to look for a gradual improvement after the first of the year.

The Osgood Bradley Co., Worcester, has just received an order from the New York, New Haven & Hartford Railroad Co. for 100 coaches of varying styles to cost between $8,000 and $10,000 each. The order includes 52 unvestibuled coaches of latest pattern for use on accommodation trains, two coaches with smoking-rooms, 15 smokers, 10 combination baggage and smoking cars, five combination baggage and passenger cars, four baggage and mail cars, three postal cars and nine baggage cars. The order approximates $900,000. The cars are to be put into service immediately on completion

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The next meeting of the Crucible club will be at Jackson, O., the last Saturday in January. The last meeting held here was an interesting one and several interesting papers are to be given at the coming session.

NEWS FROM MANY INDUSTRIES

New Buyers:—

The Lattimer Machine & Supply Co., Lattimer, Pa., has been organized with a capitalization of $25,000 by A. D. Calvin Jr. and Ario Pardee and A. W. Drake.

The Nampa Iron Works, Ltd., Nampa, Idaho, capital $25,000, has been incorporated by C. S. Russell, C. A. Peters and Rexy L. Baily.

William Nelson, Samuel H. Beck and Robert Milne have organized the Rockford Drilling Machine Co., Rockford, Ill., with a capital of $50,000.

W. H. Mack, Thomas A. Dicke and M. J. Dain have organized the National Chuck & Tool Co., Camden, N. J., with a capital of $50,000 to manufacture chucks, tools, etc.

The Milton Foundry & Machine Co., Milton, N. Y. capital $6,000, has been chartered by Oscar Winegard, Milton, N. Y.; Theodore Schweickert and George Paepplein, Brooklyn.

The Alabama Coal & Steel Co., Birmingham, Ala., has been organized with a capitalization of $300,000. The officers of the company are: President, Edward Z. Anderson; secretary and treasurer, Charles J. Ingalls.

The Warren C. Bogue Machinery Co., Denver, has filed articles of incorporation with a capital of $100,000. Those interested are: Warren C. Bogue, Bradish P. Morse and Richard Wensley Jr., all of Denver.

The Continuous Zinc Furnace Co., of Hartford, Conn., has been incorporated. Capital stock, $125,000. Incorporators are: Woolsey MacA. Johnson and Charles F. Johnson, of Hartford, and Ephraim Williams, of New York.

The Gallaudet Engineering Co., Dayton, O., has filed articles of incorporation with a capital of $50,000. Those interested are: Theodore Sheldon, Edson F. Gallaudet, Charles A. Craighead, Ezra M. Kuhns and Walter B. Gebhart.

The Dexter Machine Co., Attleboro, Mass., has been chartered with an authorized capital of $50,000. The officers of the company are: President, Charles S. Dexter; treasurer, Mary E. Dexter; clerk, Byron Rose, all of the address given above.

The Australian Rider-Ericsson Engine Co., New York, capital $10,000, has been incorporated by William M. Seyer Jr., Leander A. Bevin and Robert H. Halstead, 35 Warren street, New York. The company will deal in engines and machinery, etc.

Articles of incorporation have been filed by the Conrad Nuhn Iron Works, New York, with a capital of $10,000 to manufacture iron work. The incorporators are: Conrad Nuhn and Emma Nuhn, Richmond Hill, N. Y., and George Jine, Carlstadt, N. J.

The Swedish Iron & Steel Corporation, New York, capital $450,000, has been formed by John H. Brewster, 71 Beaver street; Harry S. Stallknecht, 16 Exchange place, and John F. Valieant, 5 Nassau street, all of New York, to manufacture iron and steel, etc.

With a capital of $10,000 the Weisz Rotary Piston & Atmospheric Motor Co., New York, has been chartered to manufacture machinery. Among those interested are: Albert R. Weisz, 97 Lewis avenue, Brooklyn; John M. Reiner and John L. Reiner, Little Britain, N. Y.

The Scott Mfg. Co., Medford, Mass., carbureters, etc., has filed articles of incorporation with a capital of $75,000. The officers of the company are: President, Joseph R. Livermore, Cambridge; treasurer, Russel G. Scott, Pittsfield; clerk, Henry J. Livermore, Medford.

The B. H. Pugh Mfg. Co., Topeka, Kas., has been formed by C. O. Knowles, John F. Switzer, Porter S. Cook, of Kansas City; P. W. Griggs and P. H. Pugh, to manufacture a line of potato machinery, including diggers, planters, sorters and cutters. The headquarters will be at 305 Kansas avenue, Topeka.

The United Gas Machinery Co., New York, has been chartered to manufacture gas and other engines and motors, etc. The capital stock of the company is $100,000, and the incorporators are: C. Monlieth Gilpin and Harry A. Stuart, 68 William street, and Leonard McGee, 239 Broadway, all of New York.

The Layne & Bowler Co., Houston, Tex., has been incorporated with a capital of $300,000 with the following officers: President, M. E. Layne; vice president, P. D. Bowler; secretary and treasurer, M. D. Fields; directors, E. B. Parker, W. B. Chew, W. H. Kirkland and E. A. Peden. The company will continue the manufacture of patent centrifugal pumps, patent oil and water well screens, etc.

With a capital of $40,000 the Vulcan Rail & Construction Co., Brooklyn, has been formed by William B. Cater, 92 Norman avenue; Thomas M. Cater, 382 State street, both of Brooklyn; Henry M. Robinson, 12 Llewellyn road, and Charles W. Weston Jr., 154 Orange road, both of Montclair, N. J. The company will manufacture structural iron work, manufacture and deal in iron, steel, etc.

The Standard Steel Works Co. has been organized to succeed the old Standard Steel Co. in the ownership and management of the works at Burnham, Mifflin county, Pa., from which the Baldwin Locomotive Works draws its supply of steel for locomotives. The incorporators are all Baldwin men, including John H. Converse, George Burnham, William Burnham, W. P. Henszey, W. L. Austin, Samuel M. Vauclain and Alba B. Johnson, of Philadelphia. The capital stock of the company is $10,000, which will be increased to $7,000,000. The old company was organized 30 years ago.

New Construction:—

The Marshalltown Drop Forge Co., Marshalltown, Ia., is repairing the damage incurred from a recent fire. Most of the damage was in stock, but this was covered by insurance.

Contemplated improvements at the Union Iron Works, San Francisco, Cal., have been deferred owing to the recent money stringency, but are likely to be taken up in the near future.

The Carnaham Stamping & Enameling Co., Canton, O., is enlarging its plant by the erection of a large one-story building, half of which will be used by the stamping department and the remainder by the box-making department.

The new plant of the O. O. Storle Valve Co., Kewaunee, Wis., was placed in operation on Jan. 2. This concern will make a specialty of the manufacture of high pressure valves and hydrants and has just completed a commodious brass and gray iron foundry.

The fire which recently damaged the Berwick, Pa., plant of the American Car & Foundry Co., is reported by the company to have been insignificant, and it has not interrupted the operation or the output of cars. The company will rebuild the burned structure after the insurance adjustment, doing the work itself.

The Marshall Car Wheel & Foundry Co., Marshall, Tex., is erecting a new foundry 130 x 265 feet, to replace the one recently damaged by fire. Castings are now being made in a temporary structure. The new plant

will be completed about Feb. 1. The producing capacity has been increased about 50 per cent.

Charles Kane, proprietor of the Mountain State Boiler Works, at Parkersburg, W. Va., which was recently destroyed by fire, is having erected a temporary building to carry him through until spring, when a concrete building will be erected. A stock company will be formed with $25,000 capital and a large increase made in the equipment of the plant.

The Kokomo Brass Works, Kokomo, Ind., expects to rebuild at once the portion of its plant recently destroyed by fire. The damage was confined principally to the stock room and pattern room, which were almost completely destroyed, but the insurance is ample. Charles T. Byrne is president and secretary, and John W. Johnson, treasurer and manager.

The Billingham Iron Foundry Co., Trenton, N. J., which sustained the destruction of its machine shop by fire recently, has cleared the site preparatory to rebuilding at once. The company's loss was about $5,000, including damage to machinery from the heat. The company expects to have its plant in readiness for operation in about a month's time.

The Twice-Two Cycle Engine Co., 11-19 South Jefferson street, Chicago, recently organized, is promoting a new type of gasoline engine. The company intends to go into the manufacture of the engine at once, and if justified by results, will probably increase the company and eventually own its own plant. E. R. Casebeer is president, and H. Ray Kinsley, secretary and treasurer.

The new plant in the course of erection by the Tiffin Malleable Iron & Chain Co., Tiffin, O., has practically been completed and operations are expected to be inaugurated early in the new year. Among those interested in the new enterprise are: T. K. Webster, of Chicago, president of the Webster Mfg. Co.; T. K. Webster Jr., who will be secretary and treasurer of the new company, and H. L. Waterbury, manager.

The Worswick-Haardt Harvester Co., Montgomery, Ala., recently incorporated, reports that it will confine its operations this year to merely the manufacture of cotton pickers. As it will be impossible to build and equip a plant for the purpose of manufacturing the machines for this year's market, the company proposes to test and assemble the parts itself. Accordingly it is in the market for 60-horsepower light weight gasoline engines, suction blowers up to 900 cubic feet per minute capacity at 6 to 8 ounce suction, steel wheels for truck, suction hose, etc. It is not expected that any effort to put up a plant of any size will be made before July or August.

General Industrial Notes:—

The Dallas Gin & Foundry Co., Dallas, Tex., has leased its plant to the Southern Foundry Co. This concern will engage in the manufacture of cotton gins.

Col. Boone, of Zanesville, O., is endeavoring to interest boards of trade in this section in the establishment of a plant for construction of hot air furnaces, which is now in operation in Youngstown, O.

The Berwick car works of the American Car & Foundry Co., Berwick, Pa., resumed work last week on a large car order. It is said that conditions are also better at Middletown and Milton car works.

Formal transfer of the mills of the National Wire Co., New Haven, Conn., to the United States Steel Corporation was made Dec. 23, when a check for $615,000, payable to the receivers of the wire company, was accepted in the bankruptcy court.

The Jones-Gregg Co., Rock Falls, Ill., recently incorporated, will manufacture a line of paper mill machinery from designs and patents which it holds. The company does not propose operating a factory at present, but will have its machines built on contract by outside engineering houses.

Owing to the rapidly increased demand for its goods, the Curtis & Curtis Co., Bridgeport, Conn., has just completed a large addition to its works which gives it much larger facilities than it has heretofore enjoyed. The company manufactures pipe cutting and threading machinery.

The Ensign works of the American Car & Foundry Co., at Huntington, W. Va., will not, it is officially announced, turn out early in the coming year, an order for 2,000 steel cars for one of the big western railroads, as reported last week in the papers of the district. The foundry has been working slack time for several weeks.

Reports from Portsmouth are to the effect that the Portsmouth Steel Co. is receiving material and that there is some chance of the mills resuming early in the new year, although no official announcement to this effect has been made. The only present activity at the plant is in the foundry department and work on the new bar mill.

At a recent meeting of the Trustees of the Commons, New Castle, Del., the agreement with the Tropenas Steel Co. to purchase for that company 100 acres of land at a cost of $7,900, was accepted and the deal ordered closed. The company binds itself to place the plant in operation by Sept. 1, 1909, and to operate continuously for a period of 10 years or forfeit the property to the trustees.

The Wisconsin Blower Co., of Milwaukee, recently incorporated, will conduct an established business which was originally operated under the name of Cordts & Ehmke. The company is engaged in the manufacture of galvanized iron and general sheet metal work in connection with heating and ventilating apparatus, and this department will be continued. Its present purpose is to execute contracts for the entire system of heating by fans, furnishing not only the sheet metal work, but the entire apparatus. The company also manufactures and installs dust collecting systems and dust separators. Recent contracts taken for its heating and ventilating apparatus are as follows: Majestic Theatre, Milwaukee; Stoughton High School, Stoughton, Wis.; Bessemer High School, Messemer, Mich.; Escanaba High School, Escanaba, Mich.; Neenah High School, Neenah, Wis. Fans, blowers and heating apparatus of an eastern concern are now being handled, but eventually the company expects to build these itself.

Trade Notes:—

The Northern Engineering Works, Detroit, has installed one of its No. 54 Newten cupolas at the plant of the Standard Pulley Co., Cincinnati. The company reports export shipments of Newten cupolas to Havre, France, and to Genoa, Italy.

Fires:—

The foundry of Wilcox, Crittenden & Co., Middletown, Pa., was damaged about $3,000 by fire Dec. 20.

The plant of the Holbrook-Armstrong Iron Co, Racine, Wis., sustained a loss of $15,000 by fire recently, which originated in the engine room and spread to the machine shop, molding shop and pattern rooms. Insurance is ample. The company was visited by a similar misfortune last May.

The Pratt & Cady Co., Hartford, Conn., makers of machinery, have just bought 1,200 tons of pig iron, delivery to commence at once.

THE IRON TRADE REVIEW

Volume XLII CLEVELAND, JANUARY 9, 1908 Number 2

LOWER PRICES

ANNOUNCED ON BAR IRON, SHEETS AND TIN PLATE.

Furnace Men Hold Meetings.—Rapid Decrease in Blast Furnace Production.—Plant Resumptions.

The principal events of the week have been the gradual and cautious resumption of finishing mills, the announcement of sharp reductions in prices on a number of finished products and the meetings of eastern and western pig iron manufacturers who are endeavoring to prevent decline of prices below the cost line.

Blast Furnace Production

The startling change in industrial and financial conditions since last October is reflected in statistics of blast furnace production, which decreased from 2,359,690 tons in October to 1,234,733 tons in December. The active capacity at the end of December was 154 blast furnaces, against 226 on Nov. 30. For the year 1907 the blast furnaces of the United States produced 25,299,732 tons of pig iron, the charcoal product not included. This compares with a total tonnage of 24,874,184 tons in 1906. Estimating charcoal iron production at 450,000 tons, the total output for 1907 was, approximately, 25,750,000 tons.

Pig Iron Men Meet

Pig iron manufacturers have made an earnest effort during the past week to prevent prices from further declines. The meeting of Shenango and Mahoning valley furnacemen was not harmonious, as two interests declined to cooperate with the others, and, as a result, quotations are irregular. No important interests were unrepresented at the eastern meeting, and there is a fair prospect of better conditions being established. The promise of improvement in the Chicago district has not been borne out by experiences of the past few days. More interest in the market is manifested at Buffalo and Cleveland and increased sales are reported in Philadelphia. In southern irons the most important transaction was the sale of 10,000 to 12,000 tons made to the leading pipe interest at a price not announced, but understood to be on a basis of slightly below $13 Birmingham for No. 2. Some southern interests are openly quoting $13, but a few sales are reported at a somewhat higher figure.

Reduced Quotations

In finished lines a number of important reductions in price have been made. The Western Bar Iron Association has reduced its quotation on common iron bars $4 per ton. Sheet reductions are as follows: $2 per ton on black sheets, with the exception of Nos. 29 and 30, on which a $4 reduction is made; $4 per ton on galvanized sheets, excepting Nos. 29 and 30, where the cut is $6; $1 per ton on blue annealed sheets; $2 per square on painted and galvanized roofing sheets. Tin plate has been reduced 20 cents per base box, or $4 per ton. Cast iron pipe has declined $1 per ton, and there has been some further cutting on light rails.

Resumption of Plants

A number of finishing mills have resumed operation, but the disposition is not to do so unless there is a good prospet of being able to continue for a reasonable time. The Youngstown Sheet & Tube Co. has resumed in all its departments, but does not expect to operate beyond Saturday. This announcement, like others from similar plants, shows that news of plant resumptions cannot always be accepted as positive evidence of return of prosperity. There is, however, general hope for a fair amount of orders at a not far distant date. On Dec. 31 there were but 29 of the 96 workable furnaces of the United States Steel Corporation in operation. The Tennessee Coal, Iron & Railroad Co. had six stacks active and 11 idle.

NEW HOPE

And a Fair Prospect of Revival of Industries on the Pacific Coast.

(Special Correspondence.)

San Francisco, Jan. 3.—The new year has brought new hope to the people of San Francisco, hope and a fair prospect for an early revival of activity in the iron industries. The stagnation in business shortly before the close of the past year became the more apparent because it followed closely upon a long period of exceptional activity. Local manufacturers ascribe the decline in business to cessation of construction work by the railroads and the closing of the mines in Nevada. Proprietors of iron works and the foundrymen are confident that, with the resumption of work on the new railroad lines and the reopening of the Nevada mines—both events being expected with the next few weeks—the shops will become quite busy with new orders. The coming of the nation's fleet is the event to which San Franciscans and nearly all Californians look with a great deal of pleasurable anticipation. There is no doubt that the coming of the fleet will bring a large portion of the inhabitants of the Pacific slope to San Francisco, and make times as lively as have been experienced on important occasions before the great fire.

The coming of the fleet will benefit San Francisco and the Pacific coast in more than one way, and some of the benefits to accrue will be permanent.

The government certainly lacks facilities for handling big ships in Pacific waters, and more especially suffers from the absence of drydocking facilities, and that fact will become more apparent when the fleet comes to Pacific waters.

THE WEEK IN IRON CENTERS

PITTSBURG.

Prices of Sheets and Tin Plate Reduced—Furnace Men Not Harmonious.

Office of THE IRON TRADE REVIEW, 521 Park Bldg., Jan. 7.

The first week of the new year has seen some few slight improvements in the situation, but they are so small, in comparison with the whole, that, while they make a good talking point, and, in the general inaction, stand out prominently, and are conspicuous, there are much larger factors in the background lying dormant or barely creeping along.

The chief item of interest during the past week has been the reduction on the part of both the leading interest and independent manufacturers of sheet products, tin plate and roofing. After a series of conferences tin plate was reduced 20c per base box, black sheets $2 per ton, galvanized sheets $4 per ton, and blue annealed sheets $1 per ton. There was some opposition on the part of independent manufacturers to reducing the price of black sheets, but this was finally overcome. The reduced cost of pig tin, spelter and sheet and tin bars was largely instrumental in the reduction of prices of all except black and blue annealed sheets. On these last two items manufacturers pointed out that the present low market price of sheet mill scrap just about evened them up on the reduced price of bars. It is too soon after the announcement of the new prices to ascertain if this move is going to have the desired effect of stimulating business, but there is every reason to believe that it will, because as yet only a comparatively small part of first quarter canning requirements has been covered. Several independent tin plate manufacturers have importuned producers of bars to rush shipments and have endeavored to place new business for quick deliveries, but find that they cannot be accommodated as readily as they imagined, mills not being disposed to resume unless there is enough business actually specified ahead to warrant continued operation for some time ahead.

Business conditions, as far as money is concerned, have shown an improvement and the clearance house certificates are being withdrawn, only three of the 68 Pittsburg banks using them. The banks have sent out notice that with the next pay roll they will supply the cash. Indications point to an early discharge of receivers for the Westinghouse Machine Co. The courts on Monday appointed the Commonwealth Trust Co., of Pittsburg, receiver for the General Castings Co., of Verona, Pa., near Pittsburg. The appointment was made on a bill of equity by Daniel Eagen, who claims the company owes him $100,000. The Western Bar Iron Association has revised its quotations, making a reduction of $4 per ton on common iron bars. Coke quotations are erratic. The Frick Coke Co. has announced a general reduction of wages in the regions. The scrap market is dead.

Pig Iron.—Despite the efforts of a majority of producers of valley pig iron to fix a market and hold it, conditions in the Pittsburg district at the present time are exceedingly erratic. During the week producers of foundry pig iron held a meeting and endeavored to establish a $17 price to continue through the first half of the year, but on account of the opposition of two interests, both of them large producers, although one cannot be strictly considered a valley interest, the price was fixed officially at $17 valley for the first quarter of the year on No. 2 northern foundry iron. Since that time this price has been materially shaded by the two interests which revolted, and $16 at the furnace has been mentioned, although there is no verification in the way of actual sales upon which to base this quotation as the market. We note several sales, however, at considerably above this price, one 250-ton lot going at $17.50 valley, and another 50-ton lot at the same figure. Foundry iron, however, can be bought in small lots at $17 furnace. We note the sale of 2,000 tons of gray forge iron at $16.75 Pittsburg, and another lot of 5,000 tons at the same rate, for deliveries running through January and February, none of it going beyond that period. The furnaces making the sales do not take the 90c freight from the valleys. With the uncertainty in buying and the small tonnages involved in the inquiries received, there is less stability of quotations at the present time than there has been since the big slump, despite the efforts to brace up the situation. It is true, however, that, with the two exceptions noted, where interests refused to accept the action of the recent conference, quotations are uniform and are being maintained, and this show of strength will in all probability have the effect of stiffening the situation within the next week or ten days. There is comparatively no inquiry for steel-making iron, and although the official quotation is still $19 valley, this can be shaded on prompt iron, and we quote $18.50 valley on Bessemer, and $17 valley on basic, although there are several rumors of both grades having sold during the week at lower figures. Reports received in Pittsburg are that but four of the 19 valley merchant furnaces are in blast, as follows: Brier Hill, Lowellville, Girard and Youngstown Iron & Steel. No 1 Shenango furnace is still operating and one Andrews & Hitchcock furnace is on foundry iron. The Bessemer average for December was $18.87½. We quote as follows on first quarter pig iron:

Bessemer, Valley	$18.50 to 19.00
Bessemer, Pittsburg	19.40 to 19.90
No. 1 Foundry, Pittsburg	18.40 to 18.90
No. 2 Foundry, Pittsburg	17.90 to 18.40
Gray Forge, Pittsburg	16.75 to 17.25
Basic, Valley	16.50 to 17.00
Basic, Pittsburg	17.40 to 17.90

Ferro-Manganese.—The past week has brought out one or two small inquiries for ferro-manganese, and a few small sales have been made, but the market is quiet and apparently firm at $50.50, delivered Pittsburg, on foreign 80 per cent, although we have heard of quotations slightly lower.

Imported 50 per cent ferro-silicon is quoted $93 Pittsburg on forward deliveries; domestic 12 per cent, $34; 11 per cent, $33; 10 per cent, $32. The lower grades of imported ferro-silicon are quoted 50 cents lower. These quotations are applicable to Pittsburg territory.

Plates.—The manner in which plate shipments are keeping up has been a surprise, production figures showing about 70 per cent of normal for December. There is one big plate construction job on which bids are about to be asked, but the volume of new business to date is practically nothing. The pipe companies are running very light. The steel car companies are taking out their specifications in good shape, but their remaining contract tonnages are comparatively small, and they are receiving absolutely no new business and have only enough ahead to operate not longer than six or eight weeks at most. There has been no intimation of a change in prices, and if made at all, this will not happen until there are some signs that this action would stimulate a buying movement. We continue to quote:

Tank plate, ¼-inch thick, 6¼ to 100 inch, 1.70c f. o. b. mill Pittsburg.

Extras are as follows per 100 pounds: Boiler and flange steel plates, 0.10c; A. B. M. A. and ordinary firebox steel plates, 0.20c; still bottom steel, 0.30c; marine steel, 0.40c; locomotive firebox steel, 0.50c; all sketches, excepting straight taper plates varying not more than four inches in width at ends, narrowest end not being less than 30 inches, 0.10; circles, 0.20c. Plates in width over 100 inches up to 110 inches, 0.05c; over 110 inches up to 115 inches, 0.10c; over 115 inches up to 120 inches, 0.15c; over 120 inches up to 125 inches, 0.25c; over 125 inches up to 130 inches, 0.50c; over 130 inches, 1.00c. Gages under ¼-inch to and including 3/16-inch plate on thin edges, 0.10c; under 3/16 to and including No. 8, 0.15c; under No. 8 and including No. 9, 0.25c. Five cents extra for less than carloads. Terms, net cash in 30 days.

Sheets.—The leading interest, as well as independent manufacturers, after a series of conferences over the past 10 days, during which all phases of the situation were thoroughly reviewed, has announced a reduction of $2 per ton on black sheets with the exception of Nos. 29 and 30 where a $4 reduction is made; $4 per ton on galvanized sheets, with the exception of Nos. 29 and 30, where the cut is $6 and $1 per ton on blue annealed sheets; $2 per square on painted and galvanized roofing sheets. These reductions follow a general reduction in cost of manufacture and material. The changes in prices became effective Monday, Jan. 6. It will take a week or 10 days to determine whether the new prices will have the desired result of stimulating buying. We revise our quotations as follows:

Black steel sheets, one pass, cold rolled: Nos. 11-12, 2.10c; Nos. 13-14, 2.15c; Nos. 15-16, 2.20c; Nos. 17-21, 2.25c; Nos. 22-24, 2.30c; Nos. 25-26, 2.35c; No. 27, 2.40c; No. 28, 2.50c; No. 29, 2.60c; No. 30, 2.70c. Galvanized: Nos. 10-11, 2.45c; Nos. 12-14, 2.55c; Nos. 15-16, 2.65c; Nos. 17-21, 2.80c; Nos. 22-24, 2.95c; Nos. 25-26, 3.15c; No. 27, 3.35c; No. 28, 3.55c; No. 29, 3.70c; No. 30, 3.95c. Blue annealed: Nos. 11-12, 1.85c; Nos. 13-14, 1.90c; Nos. 15-16, 2c. Corrugated roofing, $1.75 per square for No. 28 painted, 2½-inch corrugation, and $3.10 per square on galvanized roofing, 2½-inch corrugation, No. 28.

The differential between Nos. 29 and 30 gage on the base, No. 28, has been changed, and in black sheets, the differential is now 10 cents instead of 15 cents heretofore, and on galvanized the differential on No. 29 and No. 30 is 15 cents instead of 25 cents heretofore.

Tin Plate.—All interests, effective Jan. 6, announced a reduction on first quarter tin plate of 20c per base box, or $4 per ton. With this announcement the leading interest started four of its tin mill plants and is now operating about 40 per cent of its capacity. Independent interests anticipate an early resumption with bookings expected as a result of the lower prices. There are practically no stocks at any of the plants. We revise quotations as follows:

Coke tin plate, 100-pound basis, 14 x 20, $3.70 f. o. b. mill, Pittsburg district. Terms, 30 days, less 2 per cent for cash in 10 days.

Rails and Track Material.—There is but little new inquiry for standard rails from steam roads and the traction lines in the market are offering unsatisfactory terms of payment, which mills are not inclined to accept. The new 1908 Bessemer rail specifications did not have the result anticipated—that of bringing out orders for shipment on suspended contracts, the tonnage of which in Pittsburg alone is nearly half a million tons. Light rail shipments have been good, above expectations, in fact, and the movement has been easy. We quote as follows for Bessemer rails on present section specifications:

Fifty-pound and heavier, 500-ton lots and over, $28; carloads and less than 500 tons, $30; less than carload lots, $32; 8-pound, $38; 12-pound, $34 to $37; 16-pound, $32; 20-pound, $31; 25 to 45-pound, $30; angle splice bars for standard sections, $1.65c; standard spikes, $1.90 Pittsburg; hand spikes, $2 to $2.05 Pittsburg.

Steel.—The resumption of tin plate plants has had the result of releasing a large number of suspended specifications against old contracts, and there is some inquiry in the way of new sheet bar business. Consumers will experience some difficulty in getting prompt service from the mills because of the sudden resumption. While the Shenango mill of the Carnegie Steel Co. at New Castle is making sheet bars, as well as Republic, and Youngstown Sheet & Tube Co., at Youngstown, and Lackawanna has started a part of its open-hearth department at Buffalo, the leading interest, with which many are tied up by contract, will not put on Mingo, Bellaire or Youngstown until there is sufficient business ahead to warrant operation for at least a month. There is some uncertainty as to steel prices, although the official price is $28 Pittsburg. The spread between pig iron and billets is greater now than it has been since the middle of 1904. Mills are firm now, but no big business has been offered to tempt them. There is a show of resistance on the part of independent consumers of semi-finished steel toward paying the fourth quarter 1907 price named in old contracts, in view of the reduction for new first quarter 1908 business. While the official 1907 last quarter price of sheet bars was $31, the general average was nearer $30, and the new price is $29 mill. Bessemer and open-hearth small billets are quoted $28 Pittsburg, and sheet bars $29.

Hoops and Bands.—The orders to ship have been better since the first of the year and quite a few suspensions have been released. The new buying has been light, although there has been some of it done. Mills are holding firm at present prices and we continue to quote:

Hoops in carload lots, 2c; in less than carload lots, 2.10c; bands, 1.60c; base half extras as per standard steel.

Merchant Bars.—The release of suspensions has been greater on steel bars than in any other line of finished material, but the movement is still light. Agriculture and wagon interests are not coming out as heavy as expected and the inference is that while their stocks of mill material are light, they are carrying unusually heavy stocks of completed implements, and will work them off before resuming construction requiring more material.

Members of the Western Bar Iron Association have agreed that, beginning Jan. 8, their price on common iron bars shall be 1.40c base Pittsburg for western shipments. This is a reduction of $4 per ton on the heretofore accepted official price of 1.60c base price Pittsburg. For Pittsburg and Pittsburg district distribution, the local price, as agreed upon, was 1.55c Pittsburg, but it is probable that this price will eventually sag to 1.50c base Pittsburg. We quote:

Common iron bars, 1.50c to 1.55c Pittsburg in carload lots and over; 1.55c to 1.60c in less than carloads; 1.40c base Pittsburg plus freight to point of shipment on western deliveries; Bessemer steel bars, 1.60c net for future deliveries; 1.85c to 1.95c out of stock; plow and cultivator, 1.60c net; channels, angles, zees, tees, under three inches, 1.70c, all f. o. b. Pittsburg. The following differentials are maintained on steel: Less than 2,000 pounds, 0.10c advance; less than 1,000 pounds of a size, 0.30c advance. Cold rolled and ground shafting, 50 per cent off in carloads, and 45 per cent in less than carloads, delivered in base territory; open-hearth spring steel, 2.25c to 2.50c; sleigh shoe flats, 1.60c to 1.65c; smooth finished machinery

steel, 1.90c to 2c; toe calk, 2.10c to 2.15c. Planished and machine straightened tire steel is 1.80c base. Iron finished tire under 1½ by 1½ inches, 1.75c; iron finished tire, 1½ to ½ inches and over, 1.60c base. All tire subject to ½ extra on the steel card.

Structural Material.—Despite the fact that fabricating companies are holding out inducements in the way of low construction prices, the number and size of inquiries have been small. In the building trades, work started before the slump is, as a rule, being carried through, and material is being shipped by the mills, although at a reduced gait, inasmuch as fabricators are cleaning up stocks as closely as possible. Industrial extensions, however, with but few exceptions, are being held in abeyance, to await better financial conditions. We continue to quote:

Beams and channels, 15-inch and under, 1.70c; over 15 inches, 1.90c; zees, 1.70c; tees, 1.75c; angles from three to six inches inclusive, 1.70c; over six inches, 1.80c; universal and sheared plates, 6¼ inches and wider, 1.80c base.

Merchant Pipe.—The merchant pipe business is slow, although there is some new business in carload lots moving. Two furnaces and about one-half the furnaces at the McKeesport plant of the leading interest are back into commission. Prices are being firmly maintained all along the line on steel pipe, although there is some variation in the quoted discounts of wrought iron pipe manufacturers. On steel pipe we quote the following official discounts of the leading interest in large lots, to consumers:

	—Steel—	
	Black.	Galv.
⅛ and ¼ inch	65	49
⅜ inch	67	53
½ inch	69	57
¾ to 6 inches	73	63
7 to 12 inches	70	55
EXTRA STRONG PLAIN ENDS.		
⅛ to ⅜ inch	58	46
½ to 4 inches	65	53
4½ to 8 inches	61	49
DOUBLE EXTRA STRONG PLAIN ENDS.		
½ to 8 inches	54	43

Boiler Tubes.—The lack of railroad orders for new locomotives and the disinclination of builders to speculate on futures, is being felt by boiler tube manufacturers. But a small percentage of first half business usually placed by this time is on the books of manufacturers. We continue to quote the following discounts:

	Iron.	Steel.
1 to 1½ inch	42	47
1¾ to 2¼ inch	42	59
2½ inch	47	61
2¾ to 5 inch	52	65
6 to 13 inch	42	59

2¼ inches and smaller, over 18 feet, 10 per cent net extra.
2¾ inches and larger, over 22 feet, 10 per cent net extra.

Coke.—Coke prices are erratic and there is no generally accepted market either on spot or contract coke. Since the sale to a Cleveland furnace interest last week for its requirements through the early part of the year, there has been but little business closed on contract, and spot furnace coke has been sold from $1.80 to $1.95 at the ovens. Contract coke for the first half or through the year is offered from $2 to $2.25, the better grades being held according to the situation, as viewed by the producers in regard to future business conditions, from $2.10 to $2.25, at the ovens. The Frick Coke Co., dating from Jan. 1, has posted notices of a general reduction of wages in the regions, the cut being from 9 to 12½ per cent. Several independent producers reduced wages beginning Dec. 1. Even at the reduced rate of production, difficulty in securing laborers is being experienced in the coke regions, the foreigners having left for their homes in Europe by thousands.

Old Material.—The scrap market continues in its role of a minus quantity. The little buying that has been done has been on account of old contracts that are now being filled out, and the exchange of small lots of steel scrap on trades between brokers. Railroad list material is going at low prices. There have been one or two 100-ton inquiries for heavy melting steel, but as far as can be learned nothing has been closed. We continue to quote the following nominal prices, gross tons, delivered in the Pittsburg district:

Heavy melting scrap, $13 to $13.50; rerolling rails, $13.50 to $14; bundled sheet scrap, $10.50 to $11; iron axles, $19 to $20; old iron rails, $17 to $18; No. 1 wrought scrap, $13.50 to $14; old car wheels, $18 to $18.50; low phosphorus scrap, $16 to $16.50; machine shop turnings, $7.50 to $8; cast borings, $6 to $7; No. 1 cast scrap, $15 to $15.50.

CHICAGO.

Hope of Improvement in Pig Iron Not Realized—New Sheet Prices.

Office of THE IRON TRADE REVIEW,
1362 Monadnock Block, Jan. 7.

The interesting feature of the week was the adjustment of store prices on sheets to meet the mill reductions of $2 per ton on light black sheets, and $4 a ton on galvanized. It is maintained that bottom prices in sheets have now been reached and absolutely no further concession will be granted. The situation is very weak as regards light rails and prices have been made $2 and $3 under those quoted. There has been, however, no announcement of a definite reduction. Cast iron pipe has been reduced $1 a ton on all sizes and with Bessemer pig selling at the levels quoted in the valley, concessions in steel bars and plates are rumored freely. Bar iron also will reach a lower level in all probability. The scrap market continues very weak. The somewhat optimistic attitude expressed regarding pig iron in the closing days of last year has not been borne out by actual developments. It is quite clearly recognized that $13 for southern, and $18 for northern foundry iron can only be reduced further through reductions in producing costs and then to a very limited extent. At the same time buyers are making it plain that they would rather pay $13.50 on an actually rising market than obtain iron for $13 that will be the same price six months hence. It has also been made plain that the ability to influence buyers to come into the market for normal tonnages, whether in pig iron or finished material, is not in the possession of producers under present conditions. It is also evident that the real return to normally prosperous and sound conditions will not be inaugurated by sales of carload or 500-ton lots, however numerous they may be. The ability or willingness of the large interests to accomplish the things which they must accomplish before entering upon another era of heavy transportation and production will have to be developed before any real change can take place. At present market activity has not improved.

Pig Iron.—The apparent reaction to higher prices in the pig iron market following the several conferences of producers is evidenced at this time only by the fact that some southern furnaces are quoting nominally $13.50 Birmingham for southern No. 2 for first half and in one instance as high as $14 is named as the price. It is safe to say that no business is being taken at those figures, as several tonnages of moderate size have been sold for delivery through the first six months at $13.25 and $13 can be done on prompt shipment iron in almost any quantity. The belief which was held a fortnight ago and apparently with good reason that iron would be sold for less than $13 has been practically abandoned. This week, however, the realization by all interests in the market that pig iron buying is not an insistent necessity from the standpoint of melters for the next 60 days, except in very small quantities and certainly not in large volume for the first half or remainder of the

year, has developed a very decided feeling of uncertainty. The evidence seems to point clearly to the fact that prices alone, whether maintained absolutely or allowed to go to pieces, will not start a buying movement. Buyers are not even picking up bargains because of the uncertainty of the future.

Some iron was sold in this market during the week. Small lots of northern and southern foundry, basic and Lake Superior charcoal made up an aggregate of about 5,000 tons. Northern iron brought from $18 to $18.50, and Lake Superior charcoal, a little weaker, was sold for $23. We quote as follows:

Lake Superior Charcoal	$23.00
Northern Foundry No. 1	19.00 to 19.50
Northern Foundry No. 2	18.50 to 19.00
Northern Foundry No. 3	18.00 to 18.50
Southern Foundry No. 1	17.85 to 18.35
Southern Foundry No. 2	17.35 to 17.85
Southern Foundry No. 3	16.85 to 17.35
Southern Foundry No. 4	16.35 to 16.85
Southern No. 1 Soft	17.85 to 18.35
Southern No. 2 Soft	17.35 to 17.85
Southern Gray Forge	16.10 to 16.60
Southern Mottled	15.85 to 16.35
Southern Silveries, 4 per cent Silicon	20.35 to 20.85
Southern Silveries, 5 per cent Silicon	21.35 to 21.85
Southern Silveries, 6 per cent Silicon	22.35 to 22.85
Jackson Co. Silveries, 6 per cent	28.40 to 28.90
Jackson Co. Silveries, 8 per cent	30.40 to 30.90
Jackson Co. Silveries, 10 per cent	32.40 to 32.90
Malleable Bessemer	19.00 to 19.50
Standard Bessemer	21.00 to 21.50
Valley Basic	19.40 to 19.90
Alabama Basic	19.35 to 19.85

Billets and Rods.—The market in billets remains as quiet as it has been and the small lots that are changing hands are at the prevailing price of $33 base, Chicago, for forging billets and $31 for rolling billets. Wire and chain rods are quoted at $37 Pittsburg.

Merchant Bars.—Bar iron mills in this district continue to hold iron bars at 1.75c nominally. Such justification as may exist for the maintenance of this level in the face of the weak scrap and iron markets is based on the small proportion of low-priced material used in manufacture, as compared with the quantity previously purchased at higher prices. Very little business is coming to the mills, however, and the period of their running upon the orders now in hand is short-lived with an apparently unchanged prospect of intermittent shut-downs. Trade from store is exceedingly light. We quote, for Chicago delivery in carload lots, as follows:

Bar iron, 1.75c to 1.78c; soft steel bars and bands, 1.78c, half extras; soft steel angles, less than 3 x 3, 1.88c; hoops, 2.18c base, full extras; planished or smooth finished tire steel, 1.98c; iron finish, up to 1½ x ½ inch, 1.93c base; iron finish, 1½ to 1½ inch and larger, 1.78c base; channel for solid rubber tire, ¾ to 1 inch, 2.28c, and 1⅛ inch and larger, 2.18c; smooth finished machinery steel, 2.18c; flat sleigh shoe, 1.83c; concave and convex sleigh shoe, 1.93c; cutter shoe, 2.36⅛c; toe calk steel, 2.33c; railway spring, 1.98c; crucible tool steel, 7c to 9c, with higher prices asked on special grades. Quotations on shafting are 54 per cent off the list, f. o. b. Pittsburg, for carload lots, and 48 per cent off for less than carload lots. On iron and steel bars from local stocks, we quote as follows: Bar iron, 2.10c, full extras; soft steel bars, $2 per 100 pounds base, plus half extras; soft steel hoops, 2.40c, full extras.

Plates.—No improvement is noted in the volume of specifications on plate contracts and while both the sheared and universal plate mills of the principal producer at South Chicago are in operation, a continuance of present conditions will soon result in their stoppage. We quote:

Plates, ¼ inch and heavier, 6¼ to 100 inches wide, either universal or sheared, 1.70c Pittsburg base. For extras see Pittsburg report. Freight rate to Chicago, 18c per 100 pounds for carload lots, and 21c for less than carload lots. Jobbers' prices for shipment from local stocks are as follows: Tank steel, ¼ inch and heavier, up to 72 inches wide, 2.20c; 3/16 inch up to and including 60 inches wide, 2.30c; 3/16 inch, 72 inches wide, 2.55c; No. 8 up to 60 inches wide, 2.40c. Flange steel, 25c extra; heads, 25c extra.

Sheets.—Prices from store on sheets, for some time past in a more or less demoralized condition, have settled at last in sympathy with the reduction of $2 on sheet bars and the sequential concession of $2 a ton on box annealed and $4 a ton on galvanized from mill, to a pretty firm basis. Changes in store prices were not made strictly in keeping with the mill reductions as the protection of stocks and the conditions of business at present make trading from store an independent proposition so far as the determination of bottom prices is concerned and it is believed that at the present level a complete liquidation has been accomplished. We quote:

Blue annealed, No. 10 and heavier, 1.85c Pittsburg; No. 28, 2.50c Pittsburg. Galvanized sheets, No. 28, 3.55c Pittsburg. Freight to Chicago, 18c per 100 pounds for carload lots and 21c for less than carload lots. Jobbers' prices on carload lots and less from store are as follows, Chicago delivery:

No. 10, 2.20c to 2.25c; No. 12, 2.25c to 2.30c; No. 14, 2.30c to 2.35c; No. 16, 2.40c to 2.50c; Nos. 18-20, 2.55c to 2.65c; Nos. 22-24, 2.60c to 2.70c; No. 26, 2.65c to 2.75c; No. 27, 2.70c to 2.75c; No. 28, 2.85c to 2.95c; No. 30, 3.25c. Galvanized sheets, Nos. 10 to 16, 3.05c to 3.15c; Nos. 18 to 20, 3.15c to 3.25c; Nos. 22 to 24, 3.30c to 3.35c; No. 26, 3.50c to 3.55c; No. 27, 3.70c to 3.75c; No. 28, 3.90c to 4.00c; No. 30, 4.45c to 4.50.

Structural Material.—The hopeful outlook for building construction demanding structural material remains, to all appearances, firmly established. A total of about 4,000 tons was contracted for with the leading producer. The Aberdeen building in St. Louis required nearly 1,000 tons and the remainder was made up of smaller lots from the neighborhood of Chicago. A new hotel is in immediate prospect in Chicago for which about 1,000 tons of steel will be needed. There are no changes in prices and we quote:

Beams and channels, 3 to 15 inches inclusive, 1.70c Pittsburg. For extras see Pittsburg report. Freight rate from Pittsburg to Chicago, 18c per 100 pounds for carload lots, and 21c per 100 pounds for less than carload lots. Quotations from store are as follows:

All angles, 3 inches and larger, including 6 inches, $2.05 per 100 pounds; angles, over 6 inches, $2.15 per 100 pounds base; beams, 3 to 15 inches inclusive, $2.05 per 100 pounds base; channels 3 inches and larger, $2.05 per 100 pounds base. Less than carload lots are $1 a ton higher than foregoing prices.

Rails and Track Supplies.—There is absolutely no demand for heavy rails and in light sections the amount of business on hand is so small that further concessions in price are imminent. Sales have undoubtedly been made, some as low as $27, but even this price has not brought out any quantity of orders. Mills of the leading producer in this district will shortly shut down if there is no improvement. We continue to quote as follows:

Bessemer rails, $28 to $30; less than 500-ton lots, $32; open-hearth rails, $29; light rails, Bessemer, 25 to 45-pound sections, $30; 20-pound, $31; 16-pound, $33; 12-pound, $34; and lighter sections down to 8-pound, $40, all f. o. b. mill. Track supplies vary in price according to quantity and delivery. On orders accompanying rail contracts for future delivery, we quote, f. o. b. Joliet: Angle bars, 1.65c; spikes, 1.90c to 2c; bolts with square nuts, 2.40c to 2.50c; with hexagon nuts, 2.55c. For carload lots or less, for prompt shipment the following prices are asked: Angle bars, 2.25c to 2.75c; spikes, 2.30c to 2.40c; bolts with square nuts, 2.75c; with hexagon nuts, 2.90c.

Merchant Pipe and Boiler Tubes.—There is nothing to report in regard to these materials other than that prices remain the same. We quote mill discounts, Chicago delivery, carload lots, as follows: On steel pipe, jobbers are

allowed a concession of one point and 5 per cent additional from the schedule in force:

	—Steel— Black.	Galv.
¼ to 6 inches, inclusive	72.0	61.2
BOILER TUBES.		
	Steel.	Iron.
2¼ to 5 inches, inclusive	62.2	49.2

Mill quotations on iron pipe are from four to five points higher than above. A concession of one point from the following quotations is allowed by Chicago jobbers on carload orders for shipment from local warehouse stocks. We quote for less than carload lots as follows:

MERCHANT PIPE.	Black.	Galv.
⅛ to ¼ inch	61	45
⅜ inch	63	49
½ inch	65	53
¾ to 6 inches	69	59
7 to 12 inches	65	50

Minimum prices for wrought iron pipe, carload lots or greater, from Chicago stocks, are as follows: ⅛ inch to ¼ inch, 55; ⅜ inch, 57; ½ inch, 59; ¾ inch to 6 inches, 64; 7 inches to 12 inches, 59. Boiler tubes from store are unchanged at 60 off for steel, 47½ for iron, and 47½ for seamless, base sizes, 2⅛ to 5 inches.

Wire Products.—It is expected that trade in wire will soon feel the effect of the usual demand from the southwest at this time of the year. It also seems by no means unlikely that steps will be taken in the very near future to encourage buying and announcements of that nature would not be surprising. We continue to quote to jobbers, Chicago delivery, as follows:

Wire nails, $2.23; painted barb wire, $2.38; galvanized barb wire, $2.68; smooth annealed wire, $2.08; smooth galvanized wire, $2.38; polished staples, $2.23; galvanized staples, $2.63. Carload lots to retailers, 5 cents higher; less than carload lots, 15 cents higher.

Cast Iron Pipe.—A further reduction of $1 a ton is offered on all sizes of cast iron pipe. Several inquiries have been received in this market for municipal work, but no serious intent to close for any extended tonnage has been evidenced. We have revised our prices and quote as follows: Four-inch water pipe, $32; 6 to 12 inch, $31; larger sizes, $30, gas pipe, $1 a ton higher.

Coke.—The coke situation is without feature. We quote nominally Connellsville 72-hour foundry coke at $2.75 to $3.00, at the ovens, and Connellsville furnace coke $2.00 to $2.25c.

Old Material.—The Santa Fe road is offering 2,800 tons of scrap this week and the Wisconsin Central about 350 tons. The strength of the market is at a low ebb and prices are correspondingly weak though changes from a week ago are few because of the lack of sales through which to determine possible fluctuations. It is becoming evident, however, that dealers are preparing to accumulate stocks though the activity in this direction is only suggested as yet and the movement will undoubtedly be uncertain and quiet for the time being. We quote, gross tons in the first paragraph, as follows:

Old Car Wheels	$19.50 to 20.00
Old Iron Rails	14.50 to 15.00
Re-rolling Rails (3 ft. and over)	12.00 to 12.50
Old Steel Rails (3 ft. and under)	12.25 to 12.75
Light Section Relayers, 45 lbs. and under, subject to inspection	21.00 to 23.00
Relaying Rails, subject to inspection	19.00 to 19.50
Frogs, Switches and Guards	10.75 to 11.25
Heavy Melting Steel	10.00 to 10.50

We quote, net tons, as follows:

No. 1 R. R. Wrouhgt	$10.50 to 11.00
No. 2 R. R. Wrought	9.50 to 10.00
Knuckles, Couplers and Springs	10.00 to 10.25
Shafting	14.00 to 14.50
Iron Car Axles	15.50 to 16.00
Steel Car Axles	15.00 to 15.50
Dealers' Forge No. 1	8.50 to 9.00
Pipes and Flues	7.50 to 8.00
No. 1 Cast, 150 lbs. and less	12.75 to 13.25
No. 1 Mill	7.00 to 7.50
Mixed Busheling (Nos. 1 and 2)	7.00 to 7.50
Country Sheet	4.00 to 4.50
No. 1 Boiler Cut	6.50 to 7.00
Boiler Punchings	10.00 to 10.50
Cast Borings	4.75 to 5.25
Mixed Borings, etc	4.50 to 5.00
Machine Shop Turnings	6.75 to 7.25
Railroad Malleable	10.00 to 10.50
Agricultural Malleable	9.00 to 9.50
Stove Plate and Light Cast Scrap	11.50 to 12.00
Old Iron Splice Bars	12.50 to 13.00

CLEVELAND.

Some Buying of Foundry Iron—Steel Plant Resumes.

Office of THE IRON TRADE REVIEW,
Browning Building, Jan. 7.

Iron Ore.—Little ore is moving from docks to furnaces, which is not unexpected, considering the comparatively small capacity in blast. Inquiries from ore sellers to patrons as to whether they wish shortages on last year's shipments to be postponed or cancelled are not eliciting definite replies in view of the uncertainty surrounding future ore prices, the users promising to submit their wishes later.

Pig Iron.—More substantial evidence of increasing interest in pig iron has been presented by the past week, one local interest reporting sales for first half delivery of upwards of 2,000 tons of No. 2 foundry iron in tonnages of 1,200, 500 and lesser amounts, at from $17.10 to $17.60 furnace. Where active competition was encountered $17 furnace was done. There have been other scattering sales at $17 furnace. The local market for foundry iron ranges from about $17.25 to $17.50 delivered Cleveland. Reports of low prices being quoted in the valley and western Pennsylvania are heard and it is stated that several interests are aggressive in making sales at concessions. In view of this the nominal price of $17 valley for foundry iron could probably be shaded. However, in the main producers are offering more resistance to price-cutting. The inquiry continues good. A Youngstown melter is in the market for 600 tons and in addition there are other inquiries for 1,000, 700, 500, and quite a number for smaller tonnages, some of which is from eastern melters. Several 100-ton inquiries for southern iron were made in the week and received quotations of $13.50, Birmingham, or $17.85 delivered, Cleveland, but the business was not placed. There is also some interest being shown in basic. It is not believed that there will be any buying movement of considerable extent among Cleveland foundrymen before 30 and probably 60 days as some iron on old contracts was carried over into the new year and new business in castings lines is not very heavy as yet. Malleable iron is held nominally at about $17, valley furnace. Additional furnaces blown out recently include the Ella furnace of Pickands, Mather & Co. and the Claire furnace of M. A. Hanna & Co. The stack of the Upson Nut Co. in this city, which was banked for repairs, has resumed. For Cleveland delivery for the first quarter we quote as follows:

Bessemer	$19.90
No. 1 Foundry	17.75 to 18.25
No. 2 Foundry	17.25 to 17.75
No. 3 Foundry	16.75 to 17.25
No. 2 Southern	17.35 to 18.35
Gray Forge	16.75 to 17.25
Lake Superior Charcoal	23.50 to 24.00

Coke.—Some contracts for furnace coke for first half delivery are being closed on the basis of about $2 ovens. Developments in foundry coke are few. For first half delivery we quote foundry coke at from $2.75 to $3.25 ovens, and furnace coke at $2 ovens.

Finished Material.—The tendency toward improvement in finished material is more marked. There is some new tonnage moving which in the aggregate is not inconsiderable. Specifications are fair. One mill in the past 10 days has disposed of 2,500 tons of plates, structural and other steel. Some transactions in open-hearth rerolling billets have been made at $31 to $32 delivered Cleveland. In tank steel one mill finds its order books so well filled that it cannot promise deliveries in less than two weeks. A number of small projects in structural lines are pending and among prospective orders is that for 750 tons for the Mahoning county court house at Youngstown, O., the general contract for which is soon to be placed. Bar iron remains weak and local mills are still inactive. Some sales of light rails are reported and local sales representatives have just been notified of a $2 reduction in price. The Bessemer plant, one of the blooming mills, and the new rod mill of the Newburg

steel plant of the American Steel & Wire Co. have resumed operations after being idle for a number of weeks.

Old Material.—The old material market continues to drift in the absence of any buying movement. Sales continue in small volume, although there is a little more inquiry by mills for steel scrap at low prices. Little improvement is expected in old material before active operations are resumed by iron and steel mills. The Michigan Central railroad has closed on a small list, and the Pennsylvania lines west with 6,000 tons and the lines east with a large list of upwards of 15,000 tons will make awards this week. Our prices, f. o. b. Cleveland, gross tons, which are largely nominal, are as follows:

Old iron rails	16.00 to 17.00
Old steel rails (re-rolling)	12.00 to 13.00
Old steel rails (under 6 feet)	12.00 to 13.00
Old car wheels	16.00 to 17.00
Old steel boiler plate	9.00 to 10.00
Steel axles	13.00 to 14.00
Malleable iron (railroad)	12.00 to 13.00
Malleable iron (agricultural)	10.00 to 11.00
Heavy steel	11.00 to 12.00
Country mixed steel	10.50 to 11.50
Low phosphorus	14.50 to 15.50

We quote net tons as follows:

No. 1 R. R. Wrought	11.50 to 12.50
No. 1 busheling	11.00 to 11.50
No. 1 machine cast	12.00 to 13.00
Iron axles	16.00 to 17.00
Axle turnings	7.00 to 8.00
Machine shop turnings	5.50 to 6.50
Grate bars	9.00 to 10.00
Pipes and flues	9.00 to 10.00
Tank iron	8.00 to 9.00
Hoop and band iron	5.00 to 6.00
Sheet iron	4.00 to 5.00
Wrought drillings	5.50 to 6.50
Stove plate	10.00 to 11.00
Cast borings	4.00 to 5.00

CINCINNATI.

One Large Sale Rumored—Increased Interest in Pig Iron Market.

Office of THE IRON TRADE REVIEW, First National Bank Bldg., Jan. 7.

Pig Iron.—The past week has developed much more interest in the market. Correspondence in the offices indicates considerable inquiry for prices, but to a large extent this is regarded as a disposition to obtain information as to figures at which pig iron is obtainable and the amount of actual intention of placing orders is in doubt. Compared with the recent dullness, there has been quite an increase in the tonnage placed. One large interest is reported to have taken 10,000 or 12,000 tons of southern iron for prompt delivery on private terms. A few 500-ton lots have been sold at $13.00 Birmingham for first half delivery and a 1,000-ton lot of analysis iron sold at $13.50 Birmingham. One inquiry calls for 2,000 tons for delivery in the last half of 1908 and there is an inquiry for 5,000 tons of basic for first half delivery. It is apparently a situation which depends for its strength upon the light stocks in furnace yards and the reduced production. The buying and inquiry appear to be prompted more by a belief that prices have declined to a safe purchasing basis rather than the outlook for the sale of finished material. In this territory, the limited call for coke indicates the light melt in the foundries and the demand for finished product is apparently not increasing or the outlook any more encouraging. Prices for southern iron for prompt delivery have been shaded and sales below $13.00 Birmingham have been made, but southern furnaces are in some instances not inclined to go beyond the first quarter of the year at $13.00 while others are seeking business at $13.00 for the first half. Quotations continue irregular. Some of the furnace interests which last week were on a $13.00 basis have advanced their quotations to $13.50 and others have reduced their prices to the $13.00 level. It may be said that a few of the larger producers are now openly quoting the minimum price. In southern Ohio $17.00 for No. 2 foundry at furnace appears to be well maintained. Ohio silvery, 8 per cent silicon, remains quotable at $22.00, but it is believed that this can be shaded. Quotations for prompt delivery and first quarter, delivered Cincinnati, are as follows, freight rate from Birmingham being $3.25:

Southern Foundry No. 1	$16.75 to 17.25
Southern Foundry No. 2	16.25 to 16.75
Southern Foundry No. 3	15.75 to 16.25
Southern Foundry No. 4	15.25 to 15.75
Southern No. 1 Soft	16.75 to 17.65
Southern No. 2 Soft	16.25 to 16.75
Southern Gray Forge	14.75 to 15.25
Northern No. 1 Foundry	18.20 to 18.70
Northern No. 2 Foundry	17.70 to 18.20
Northern No. 3 Foundry	17.20 to 17.70
Northern 8 per cent Silicon	22.70 to 23.20

Finished Material.—Specifications on contracts have been fair, but the amount of new business in the way of mill orders is light. Retail prices remain unchanged and orders from stock are moderate. Small orders are filled here at the following prices:

Angles, 3 x 3 and over, 2.15c to 2.25c; beams and channels, 15 inches and under, 2.15c; small angles and architectural channels, 2.10c base; plates, ¼ inch and heavier, 2.10c; 3/16 inch, 2.20c; No. 8, 2.20c. Iron and steel bars, $2 base; boiler tubes, 62 per cent off base; turnbuckles, 45 per cent off; rivets, 3.15c base; cold-rolled shafting, 45 per cent off list; steel tire, 2.10c base.

Coke.—The market is quiet and there is but little call for coke on contracts for prompt delivery. A few furnace contracts are under consideration. Prompt coke is obtainable at quotations below current schedules. Quotations in the leading coke producing districts are as follows:

	PER TON
Wise Country Furnace Coke	$2.00 to 2.25
Wise County Foundry Coke	2.50 to 2.65
Pocahontas Furnace Coke, prompt shipment	2.00 to 2.20
Pocahontas Foundry Coke	2.50 to 2.75
Connellsville Furnace Coke, prompt shipment	2.15 to 2.25
Connellsville Foundry Coke	2.50 to 3.00
New River Foundry Coke, prompt shipment	2.75 to 3.00
New River Furnace Coke, contract	2.30 to 2.50

Old Material.—The market continues easy, with prices largely nominal in the absence of trade. Dealers' prices are as follows:

Old No. 1 R. R. wrought, net tons	$12.00 to 12.50
Cast machine and fdy., net tons	12.50 to 13.50
Old iron rails, gross tons	16.50 to 17.50
Old steel rails (re-rolling) gross tons	12.50 to 13.50
Old short lengths, gross tons	12.50 to 13.50
Old iron axles, net tons	16.50 to 17.50
Heavy melting scrap, gross tons	13.50 to 14.00
Stove plate, net tons	10.50 to 11.50
Wrought turnings	5.50 to 6.50
Cast borings, net tons	4.50 to 5.50
Car wheels, gross tons	16.50 to 17.50

PHILADELPHIA.

One Large Order for Pig Iron Placed —More Hopeful Feeling.

Jan. 7.

Pig Iron.—The more hopeful feeling, based on increased inquiries and orders, noted last week, still continues, and the indications seem to be that the tide has turned at last. A number of large consumers are placing orders in varying amounts, among them being one concern whose order for 5,000 tons of foundry iron runs over the entire year. Pipe founders have been buying rather freely, and foundrymen generally are showing more interest in the market. No great boom is looked for in the immediate future, but if the furnaces adhere to their policy of restrictions and thus support prices, it is believed that by March there will be a marked improvement in the situation. The extent to which curtailment has been carried may best be illustrated by the statement that in the Schuylkill valley, which for many years was the center of the iron industry in America, there are now but four furnaces in operation. These are at Swedeland, Pottstown, Birdsboro and Leesport. In the Lebanon valley and along the East Pennsylvania railroad, fully a dozen stacks are idle, and in the Lehigh valley things are not in much better shape. In central Pennsylvania, the Nittany furnace at Bellefonte has been banked. Every effort is being made to prevent the accumulation of stocks, and this policy will no doubt be successful in bringing the market into a healthy condition again. Prices, which show some slight concessions, may be quoted as follows:

No. 1X Foundry	$18.75 to 19.25
No. 2X Foundry	18.00 to 18.50
No. 2 Plain	17.75 to 18.25
Standard Gray Forge	16.25 to 16.75
Basic	17.00 to 17.50
Low Phosphorus	25.00 to 26.00

New Materials.—Notwithstanding newspaper reports of mills starting up here and there, the situation is really very quiet, and very little business is reported. This is not unusual for the first week of the new year, but careful observers say it is many years, perhaps as

far back as the panic days of 1873, since there has been such a dearth of new business. The Baldwin Locomotive Works, the largest single industrial plant in the city, reflects the prevailing depression, especially in railroad orders, and has reduced working hours per day from 10 to 8. The force is also being gradually reduced, and instead of the 21,000 men employed in the busiest days of last year, the pay roll last week carried but 15,815. No change has been made in prices, which may be quoted as follows: Beams, channels and angles as according to specifications, 1.85c to 1.90c; refined iron bars, 1.75c to 1.80c; steel bars, 1.75c to 1.85c; plates, 1.85c to 1.90c.

Old Material.—There is absolutely nothing doing, and prices show a still further decline. Such quotations as can be obtained are about as follows:

Old steel rails	$13.50 to 14.00
No. 1 steel scrap	12.00 to 12.50
Old steel axles	17.50 to 18.00
Old iron axles	22.00 to 23.00
Old iron rails	15.50 to 16.00
Old car wheels	17.50 to 18.00
Choice scrap R. R. No. 1 wrought	14.00 to 14.50
No. 1 yard scrap	13.50 to 14.00
Machinery scrap	15.50 to 16.00
Low phosphorus scrap	16.00 to 16.50
Wrought iron pipe	11.00 to 11.50
No. 1 forge fire scrap	10.00 to 10.50
No. 2 forge fire scrap, ordinary	8.00 to 8.50
Wrought turnings	9.00 to 9.50
Axle turnings, heavy	10.00 to 10.50
Cast borings	7.00 to 7.50
Stove plates	11.50 to 12.00

ST. LOUIS.

Increased Number of Orders for Pig Iron and Coke.

Jan. 6.

Pig Iron.—Quite a number of local pig iron men report an unusual number of orders for pig iron and coke, from all portions of the territory contiguous to St. Louis, in today's mail. The orders generally are for delivery over the first and second quarter of 1908, but a few cover delivery over the entire year. From the interest thus manifested by foundrymen, it is believed that a buying movement is about to commence in earnest, and that the bottom has been reached in prices. Business operations are being resumed in a satisfactory manner, and cash to the fullest extent needed is freely offered by banks. One large furnace interest in the south that has been quoting No. 2 iron as low as $13, Birmingham, has advanced its price to $13.50 Birmingham, and is reported to be securing good business on that basis. Our quotations, to which $3.75 freight from Birmingham is to be added, follow:

No. 1 Southern	$14.50 to 15.00
No. 2 Southern	13.50 to 14.00
No. 3 Southern	13.00 to 13.50
No. 4 Southern	12.50 to 13.00

Coke.—The coke market remains firm at $3 to $3.25 for best grade, Connellsville 72-hour foundry coke, covering immediate and future shipments. Some inferior Connellsville foundry grade has been offered as low as $2.60 ovens, for prompt shipment only. Furnace coke is quoted at $2 to $2.25, ovens, but there is no good business in sight. Smelter grades can still be had at $1.60, ovens. Inquiries are coming in satisfactorily from foundrymen, covering the first and second quarters of 1908, and a good tonnage has actually been placed for shipment at prices stated.

The freight rate from Connellsville to East St. Louis is $2.80, and to St. Louis, $2.90. Virginia, 72-hour foundry coke, is quoted at $3, f. o. b. ovens, with freight rate of $2.80 to East St. Louis, $2.90 to St. Louis, and $2.40 when destined beyond.

BUFFALO.

Increased Activity of Plants—Sale of Pig Iron.

Office of THE IRON TRADE REVIEW,
932 Ellicott Square, Jan. 7.

Pig Iron.—An increase in inquiries and the sale by one furnace in this territory to New England interests of an order of 2,000 tons of pig iron at a price that, however, is said to be not altogether satisfactory mark the developments of the week in the local market.

Transportation for the first time in years is virtually at a standstill. There is cheering news to be had, however, in the matter of resumptions of plants. The Lackawanna Steel Co., in pursuance of its policy to operate as requirements dictate, has lighted fires under some of its open-hearth furnaces and put its plate and merchant mills back into service. The rail mill has been closed down. Two of the five sheet mills and the galvanizing plant of the Seneca Iron and Steel Co. resumed today. The Buffalo Bolt Co. and the Buffalo Radiator Co. have also resumed.

The only change to be noted in market prices from those quoted last week is a reduction of a dollar in charcoal iron. We quote the following:

No. 1X Foundry	$18.50 to 19.00
No. 2X Foundry	18.00 to 18.50
No. 2 Plain	17.50 to 18.00
No. 3 Foundry	17.25 to 17.75
Malleable Bessemer	18.50 to 19.00
Gray Forge	17.00 to 17.50
Charcoal	24.00 to 25.00

BIRMINGHAM, ALA.

Better Demand than for Several Weeks for Southern Pig Iron.

Jan. 6.

While all sales are in small lots, southern pig iron manufacturers are enjoying a better demand now than for several weeks. Indications are that there is a steady improvement started in and as a consequence, quotations are firmer now than they have been for some time. The stated prices border around the $14 per ton, No. 2 foundry, mark. During the past week there were several sales made of more than 300 tons to the lot, but the greater portion of the business was in lots of from 100 to 300 tons. Many inquiries are being received and the belief is now openly expressed that the bottom is being left behind again and that in a short while conditions will be decidedly more favorable. A readjustment of wages is being pushed in all circles in the Birmingham district, not only among the ore miners, which was noted four weeks ago, but with the coal miners, the coke pullers, at the iron works, blast iron furnaces and at the steel plants. So far, there has been no serious objection raised to the readjustment, the laborers, to all appearances, being cognizant of the fact that something had to be done in order that any operation whatever could be maintained. Cast iron pipe makers, foundries and other iron consumers, are said to have considerable business in sight and there will shortly be a need for pig iron. The accumulation of pig iron in the Birmingham district is not very extensive, the curtailment of production providing against this. One of the larger companies is reported to have 50,000 tons of iron on its yards. The smaller companies have been moving their products out right along. The Tennessee Coal, Iron & Railway Co. will this week resume operation at two furnaces at Ensley, on basic iron, the fires of the iron makers having been banked just before the holiday season started in.

A little charcoal iron is still being manufactured in this state, the Shelby Iron Co. furnace at Shelby being in operation. This furnace will, it is believed, be blown out shortly, to await a better demand for the product. A petition has been filed in the United States court, asking that the Quinn Furnace Co. be adjudicated bankrupt. A receiver has been appointed. It is understood that trustees will be appointed in a short while to take charge of the properties of the Southern Steel Co. which went into the hands of the receivers several weeks ago.

Information sought throughout the Birmingham district elicits the information that there is not much labor leaving the district and the better part of that which has gone has left word that as soon as there is a resumption correspondence will bring the people back in a hurry.

Etowah and Gadsden furnaces of the Alabama Consolidated Coal & Iron Co., Birmingham, Ala., were banked for the holidays Dec. 20, and it is expected that operations will be resumed early in January.

BRITISH IRON MARKET.

Prices Expected to Show Little Change for Several Weeks.

Office of THE IRON TRADE REVIEW,
Prince's Chambers, Corporation Street,
Birmingham, Eng., Dec. 28.

The year is closing with remarkable steadiness in pig iron, the slight fluctuations of the week leaving prices of warrants at Middlesbrough yesterday at 49s 10d ($12.20), with 1s lower for month transactions. Within the last day or two there has been a very slight increase in stocks, yesterday's record being 88,825 tons, the reduction of the month being about 7,000 tons. Hematite is still rather weaker, mixed numbers being 64s ($15.66). At the same time, makers have very little prompt iron of standard descriptions to dispose of. The general impression is that the New Year will open quietly, and there will be no particular demand for the first few weeks. There has been no meeting of the Birmingham market this week, owing to Bank holiday falling on market day. There is very little sign of weakness in the Birmingham district and such stoppages of blast furnaces as have taken place have been almost entirely for repairs. The Christmas holidays have practically produced no accumulation, and every ton made will be called for next week when the works resume. Prices are quite likely to remain fairly steady for some weeks. At the same time, the general position is slightly weaker than it was six weeks ago. Very careful inquiries will be made on Thursday next by buyers, in view of the quarterly meeting the following week. The 5 per cent addition to colliers' wages will help to strengthen the market.

NEW YORK.

Meeting of Eastern Pig Iron Producers—Higher Prices Asked.

Office of THE IRON TRADE REVIEW,
Room 1005, No. 90 West St., Jan. 7.

Pig Iron.—Eastern pig iron producers held a meeting in this city on Friday of last week for the purpose of exchanging ideas on the present situation and the outlook. This meeting was entirely independent, being connected with no existing association or committee, and was surprisingly well attended, 35 men representing all but three furnaces in this district. As nearly as can be learned, the consensus of opinion was that no reason existed for selling iron at below the production cost, as has been the case with several interests since the December slump, and furnaces generally are now asking $18.50, delivered Jersey City, or $19.50, delivered New England points, for No. 2X foundry. This level, it is stated, will be adhered to during January, as by the end of the month it is expected that the situation will be materially improved, or at least will be cleared to a great extent. The first week in January saw a better inquiry than at any time during the close of 1907. Tenders have been asked on approximately 5,000 tons of miscellaneous irons in this territory, delivery varying from a month to the entire year. The reported sale by an eastern furnace company of 20,000 tons of iron to a large manufacturing concern in New York state has been the cause of considerable comment. It discloses that this transaction was occasioned by the purchaser closing down its own furnace and making outside arrangements for its iron on a sliding scale of prices. The deal was closed shortly before the holidays and will run through the first half. Another considerable sale is reported for delivery through 1908. During the holidays the iron making capacity of the Steel Corporation was slightly below 25 per cent of the possible capacity, but the resumption of activities at a number of stacks which were banked during the season has increased this figure considerably. Steel capacity in operation is practically unchanged. It is interesting to note that, for the first time in two years, pig iron stocks in Connal's yards, Birmingham, Eng., are showing an increase. We quote tidewater prices as follows:

Northern Foundry No. 1	$18.75 to 19.25
No. 2X Foundry	18.50
No. 2 Plain	17.75 to 18.25
Malleable	19.00 to 20.00
No. 2 Southern Foundry	17.50 to 17.75
Basic	17.25 to 17.75

Ferro-Manganese.—The market is quiet, a sale of a carload being the only transaction reported. The price level is about the same, $48.00 at seaboard.

Finished Material.—By booking about 25,000 tons of new business during December, the American Bridge Co. rounded out a total of 475,000 tons closed during the year. This was 175,000 tons less than the approximate output of this interest for the year, but against this figure there is an item of about 300,000 tons, representing business carried over into the new year. Some important orders may be placed in the New York district within the near future. J. C. Rodgers has not yet closed contracts for the steel needed for the Manhattan bridge approach, for which he holds the general contract. Bids were opened last week on the hotel proposed for the Eno site, about 7,000 tons of steel being involved, and for 4,000 tons required for the initial work on the New York Central's new terminal undertaking, the completion of which will probably call for 20,000 tons additional.

In other finished lines there is little activity manifested. Bar iron mills have started up after the holiday lull and are filling the odds and ends of specifications received during the shutdown. These, however, are not heavy. The price of 1.60c, Pittsburg, is still being maintained.

We quote finished materials, New York delivery, as follows: Angles, 3 to 6 inches x ¼ inch and heavier, 1.86c; beams, 3 to 15 inches, 1.86c; tees, 3 x ¼ inch and heavier, 1.91c; plates, carloads, tanks, 1.86c; marine boiler, 2.26c; bar iron, 1.76c; soft steel bars, 1.76c; sheet, No. 28, black, 2.60c.

Old Material.—Business is almost at a standstill. Mills are not in position to take on any considerable tonnages and dealers are not inclined to sell at prices offered even on the modest business current. We quote gross tons, New York delivery, as follows:

Old iron rails	$18.00 to 18.50
Old steel rails, re-rolling	15.50 to 16.00
Relaying rails	23.00 to 23.50
Old car wheels	18.00 to 18.50
Old iron car axles	17.00 to 17.50
Old steel car axles	15.50 to 16.00
Heavy melting steel	10.50 to 11.00
No. 1 railroad wrought	12.00 to 12.50
Iron track scrap	11.00 to 11.50
Wrought pipe	9.00 to 9.50
Cast borings	5.50 to 6.00
Wrought turnings	7.50 to 8.00
Heavy cast scrap	14.50 to 15.00
Railroad malleable	15.00 to 15.50
Agricultural malleable	14.50 to 15.00
Stove plate	11.50 to 12.00
Grate bars	11.50 to 12.00

METAL MARKET

NEW YORK.

Jan. 9.

Copper.—January opens with the market distinctly improved, as compared with the closing months of the year. There is a better movement to domestic consumers, covering their needs for the next two months, and a considerable quantity of metal is still finding a market abroad. Smelters' stocks have been largely reduced, but there is no accumulation in the yards of consumers. We quote: Lake, 13½c to 14c; electrolytic, 13¼c to 13¾c; casting, 12¾c to 13¼c. *The Engineering and Mining Journal* reports the production in the United States during 1907 as 895,104,000 pounds, a decrease of 22,500,000 pounds from that of 1906.

Pig Tin.—While there is increased interest in future deliveries and the tone of the market firm, actual transactions are still relatively light. We quote 27c to 27½c for spot delivery.

Pig Lead.—Greater activity manifested during the last few days has started the trend of prices upward and considerable business is being done on the basis of 3.50c to 3.60c, New York.

Spelter.—The turn in the market has gone and there is some business going at slightly higher prices, New York quoting 4.20c to 4.30c and St. Louis 4.05c

to 4.15c. Quite a few consumers, attracted by the low level recently reached, are laying in stocks.

Antimony. — The situation is stronger, with increased trading and a better outlook. We quote: Cookson's, 9c to 9½c; Hallett's, 8½ to 9c; ordinary brands, 7¾c to 8¼c.

CHICAGO.

Jan. 7.

A slight increase in the volume of buying of copper was noted in the past week but no marked change occurred. Tin reacted sharply after a slump in the forepart of the week and lead is somewhat stronger. We have revised our prices and quote:

Lake copper, 15½c; casting, 14½c; pig tin, 30c to 30¼c; spelter, 4.75c to 4.85c; pig lead, desilverized, 4.00c to 4.10c in 50-ton lots; corroding, 4.60c to 4.75c in 50-ton lots; car lots, 2½c per 100 pounds higher; sheet zinc, 7c list, f. o. b. La Salle, in car lots of 600-pound casks; Cookson's antimony, 12½c to 13c; other grades, 12c to 12½c.

A general improvement in the price of scrap metals brought fractional advances but the amount of trading changed but little. We quote to dealers as follows:

Copper wire, 11½c; heavy copper, 11½c; light copper, 10½c; heavy red brass, 10½c; heavy yellow brass, 8¼c; light brass, 5¾c; No. 1 red brass borings, 9c; No. 1 yellow brass borings, 6¾c; brass clippings, 8½c; tea lead, 2¾c; lead scrap, 3c; zinc, 3c; tin pipe, 22c; tin foil, 18c; pewter, 15c; electrotype plates, free from wood, 3⅜c; electrotype dross, 2¼c; stereotype plate, 3¾c; stereotype dross, 2½c; prime slab zinc dross, $53 per ton.

ST. LOUIS.

Jan. 7.

Lead and Zinc.—The exceptionally light production of lead and zinc ore in the Joplin district during the last few weeks, is followed by advances in prices for the first week in the new year, and promises that the last few months of depression have passed.

Zinc ore advanced $3 and lead ore $5 a ton last week, the former selling as high as $39 and the latter at $45.

Temporarily Resumes.—The plant of the Youngstown Sheet & Tube Co., Youngstown, O., resumed operations this week, practically full in all departments, but it is expected that the works will continue on this scale only temporarily. The steel plant has been closed for six weeks, and the pipe and sheet mills have been in operation only two weeks out of six. The company anticipates that business will gradually improve.

WILL DISTRIBUTE SHELBY PRODUCTS.

The National Tube Co. has appointed the Lees-Williams Co. its distributer of Shelby seamless products for the Pittsburg district. The plan provides 15 distributers for the United States, one in each important city, as follows: Boston, New York, Buffalo, Philadelphia, Pittsburg, Cleveland, Detroit, Chicago, Cincinnati, St. Louis, Atlanta, New Orleans, Denver, San Francisco, and Portland. Each distributer has an exclusive territory, which he is required to serve by carrying stocks of listed sizes.

The National Tube Co. absorbed the selling agencies of the Shelby Steel Tube Co. on Jan. 1, and the present distributing plan is an extension of the Shelby policy, there having been previously only six distributors in the chain.

The Lees-Williams Co. is the first to carry the Shelby products direct in the Pittsburg district, and its stock of Shelby seamless cold-drawn tubing is the only stock in Pittsburg. Under the contract with the National Tube Co. the Lees-Williams Co. will supply all consumers in the district, and all orders sent to the National Tube Co. will be referred to the Lees-Williams Co. for shipment direct from its stock. The mills of the National Tube Co. will not carry stocks, and only the largest consumers will deal direct with that company.

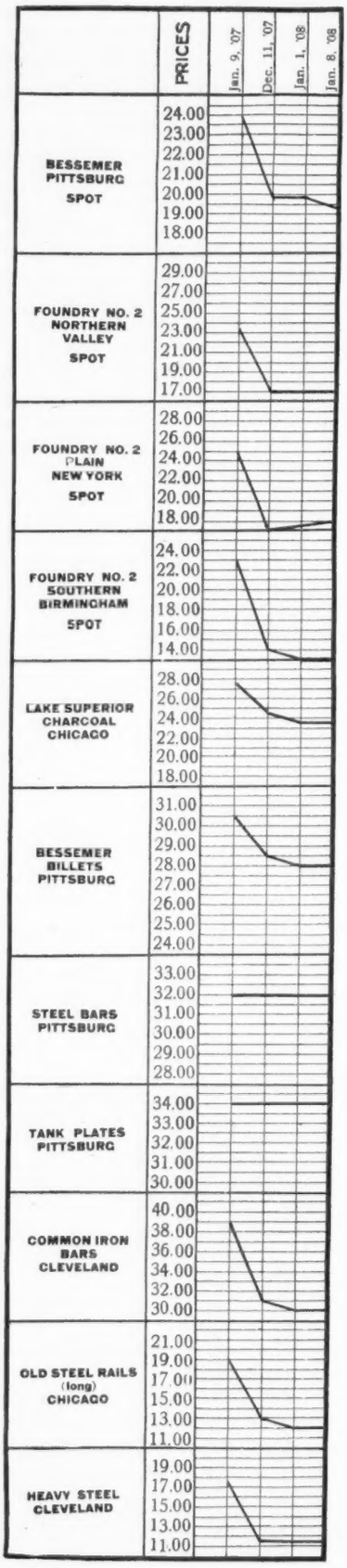
Certain changes have been made in the new Shelby price list, many odd and unusual sizes having been eliminated. It is the desire of the makers to standardize seamless tubing as far as possible, and the elimination of the less important sizes tends directly toward this result.

JAMES B. CLOW DIES.

James B. Clow, president of Jas. B. Clow & Sons, Chicago, died Jan. 7. Capt. Clow was born March 17, 1832, at Sewickley, Pa., received a common school education, served in the civil war and entered the iron and steel business at Pittsburg in 1875. The plant which bears his name was established in Chicago. Mr. Clow is survived by four sons, who are now conducting the business of the firm.

Banquet Date Fixed.—The annual banquet of the Cleveland Foundrymen's Association will be held at the Hollenden hotel, Cleveland, Jan. 28. The foundry foremen and superintendents will be guests of their employers. The representatives of various pig iron houses have also been invited to attend.

PRICE CHART.



COST SYSTEMS

And Short Weights Discussed by Pittsburg Foundrymen.

Cost systems and short weights in pig iron and coke were thoroughly dicussed at the January meeting of the Pittsburg Foundrymen's Association, held on Monday of this week. The short weight problem, in which the Pittsburg association has joined the New England and Philadelphia associations, was handled in a general discussion, which resulted in the appointment of President Herbert E. Field, of Mackintosh, Hemphill & Co., as a special representative to meet with representatives of the other associations and transportation interests in Philadelphia early in February to devise means of eliminating the difficulty which has been presented to all users of iron and coke, foundrymen in particular. In a communication, the New England association showed that shortages have averaged from 1½ to 3 per cent; that the Interstate Commerce Commission, to which an appeal had been taken, had advised that remedial measures lay in the direction of action against the transportation companies, and that the chief difficulty, to date, in securing an understanding as to liability for short weights, has been inability to get the shipper, railroads and consumer together. This will be accomplished by the Philadelphia meeting. The consensus of opinion at the Pittsburg meeting was that the chief trouble lies in accepting marked car weights, and suggestions of instruction to Mr. Field included the acceptance of tare instead of gross weights of cars, the adoption of registering beam scales, the uncoupling of cars before weighing and railroads weighing cars at transfer points, in order to establish a check between scales of shippers and consumers. It was suggested that the entrance of a weighing at railroad transfer point might only serve to still further complicate matters and render final adjustment of differences more difficult. Mr. Field was instructed to use his best efforts to obtain an adjustment of misunderstandings and assist in devising means of fixing responsibility for short weights.

The association appointed a committee to draft suitable resolutions on the death of a former vice president, A. W. Slocum, this committee consisting of Wm. Yagle, Benj. Fuller and W. B. Robinson.

The leading papers of the evening were on cost systems. Harrington Emerson, of New York, gave the association the benefit of his wide experience throughout the country in the establishment of cost and efficiency systems, pointing out the manner in which the work was done, explained the results obtained, how the division of accounts was made, and the substitution of piece for day work. By the establishment of these efficiency systems, Mr. Emerson pointed out how shop efficiency had been raised from below 50 to over 100 per cent by careful study and proper treatment of individual cases, through their gradual adoption in all branches of the establishment.

OUR ANNUAL CHART.

The annual chart published by THE IRON TRADE REVIEW, Jan. 2, shows fluctuations in the prices of iron and steel products and covers changes in quotations for the past thirteen years. A few extra copies have been printed, and will be sent, on application, in tubes to subscribers who desire to frame them. The chart is the same size as that of last year and can be easily placed in the frame, then used. The chart is a wax engraving in four colors, and gives the prices of the following products: Tank plates, Chicago; beams, Pittsburg; bar iron, Cleveland; Bessemer billets, Pittsburg; Bessemer pig iron, Pittsburg; No. 2 foundry, Chicago; gray forge, Cincinnati; No. 2 foundry, Birmingham.

The paper on "Foundry Costs," prepared by Kenneth Falconer, of Montreal, was presented, although Mr. Falconer himself was unable to be present.

Dr. Richard Moldenke, secretary of the American Foundrymen's Association, was the guest of the association at its meeting. He has been commissioned by the government to prepare for congress a report of the coke industry of the United States. He is now engaged in the work and has already visited practically all the coking coal districts of the country.

Speaking of his observations, Dr. Moldenke said the dominant feature to impress itself upon him at every point was the excessive waste now permitted in the manufacture of coke. He said a tremendous percentage of the resources are thrown away, that in the bee hive ovens there is no provision to save gas, tar or ammonia, and that instead of husbanding the deposits, by mixing high volatile and less desirable coal for coking, only the best is used, where, in his opinion, equally good product could be obtained by mixing in proper proportions. He said better coke could be made out of poorer coal, if proper methods were used.

SLIGHT IMPROVEMENT

Is Noted in the Cincinnati Machinery Market.

Office of THE IRON TRADE REVIEW,
First National Bank Bldg.,
Cincinnati, O., Jan. 6.

The year 1908 begins with the machinery trade dull but showing a slight improvement over the closing months of 1907. The outlook for the year is not well defined, but a gradual improvement is looked for and hopefully awaited. Some pending business that has been held back until the first of the year is being placed and it is expected that January will develop more of this character of business. It is generally believed that the return to normal conditions will be gradual and as expressed by one large manufacturer, representing an auxiliary line to the machinery trade when asked for an opinion as to the outlook, said, "How soon we will again return to normal conditions, I would not attempt to forecast, but some day we will find our business running along as usual and will be unable to point to a particular time when normal conditions began." This seems to express the views of the trade, and in the meantime the conditions are being met from day to day acording to the individual situation of each plant.

The effect of the holiday season has hardly been dissipated as yet and the next two weeks will probably furnish more in the way of a basis for judging the progress of affairs than the week just closed.

In the matter of the uniform form of contract for the purchase of castings, another meeting between machine tool manufacturers and the foundrymen is being arranged for. It it now believed that some of the differences can be harmonized, as it appears that concessions are likely to be made by both parties and that some of the proposed conditions which were submitted by the foundrymen and resisted by the machine tool builders will be acceded to by the machine tool builders.

Victoria furnace of the Goshen Iron Co., Goshen, Va., was blown out Dec. 19 and will not resume until trade conditions improve.

THE IRON TRADE REVIEW

Devoted to Iron and Steel Manufacture and to the Machinery, Metal-Working and Foundry Trades

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NO TARIFF REVISION.

It is gratifying to see signs that there will be no serious attempt at tariff legislation by the Sixtieth congress. The changes made through Speaker Cannon's appointment of the new ways and means committee are in the direction of conservatism, as some Republican revisionists are replaced by more conservative representatives, and the new Democratic members are believed to be more conservative, as a whole, than those who retire. The attitude of the president is generally regarded as having been made clear against revision by the present congress, as, considering his personality, there can be no doubt that, did he favor revision by this congress, his message to congress and other public utterances, would have contained positive references to the matter.

Certainly the business interests of the country have enough problems on their hands without having to face the uncertainties of a revision of the tariff, however conservatively the subject might be approached at the start.

Some idea of the character of the sentiment favoring any general change in federal laws can always be obtained by observing the bills introduced by individual members. Several such bills, looking to revising the Dingley act, have already been introduced. They can all be regarded as partaking of the nature of class legislation. The most pretentious, introduced by Representative Byrd, of Mississippi, is frankly stated to be in the interests of the planters and farmers. With cheerful abandon, this bill selects about everything used in agriculture and places it on the free list, without regard to the great differences in the rates of duty which are now in force, and which have been worked out through years of patient endeavor to formulate a coherent system.

Other bills of similar import have been introduced, all with the obvious purpose of benefiting certain interests, irrespective of the disturbance which would be wrought in other directions. There is no possibility that the tariff can be revised on any such basis, and attempts of this sort serve only to show how much sensible work must be done, and how much time can elapse, before an actual revision is accomplished.

This is one variety of special legislation. Another, which has been much in favor with congressmen desirous of making names for themselves, has been the introduction of bills removing the duty upon products made by "trusts." Curiously enough, such bills have not been as conspicuous with the present congress as in times past. Were there any approach to a general sentiment in favor of this so-called "method of curbing the trusts," a large crop of such bills would already have been harvested. This also is an evidence that there is little prospect of tariff revision by the present congress.

Leaving the evidence of freak legislation, it appears that the general trend as to the tariff is in the direction, ultimately, of making such a general and scientific revision as will change the total revenue to be obtained without materially altering the proportions of the structure except to the extent of attempting to reduce certain apparently prohibitive duties to a revenue basis. Such an attempt in the iron and steel schedules, however, would open up a very interesting discussion, since it is pretty clear that had it not been for the influence of the United States Steel Corporation the German steel syndicate would have dumped steel in the United States in certain forms during the past year. For one thing, the Steel Corporation has held prices down and prevented advances in the domestic market which would easily have admitted imports, and it would be unjust that the absence of imports, if so caused, should be argued as a reason for a reduction in the duties. There has probably been another influence, due indirectly to the Steel Corporation, in that the German syndicate has seen the opportunity for retaliation, should it try to make a dumping ground of the United States. Altogether it appears that the tariff cannot be handled by the Sixtieth congress. It is not an issue with it, and it may not be in the forthcoming national campaign.

THE SHEET AND TIN PLATE REDUCTION.

The reductions in prices of sheet products which became effective this week appear to have been dictated by sentiment rather than by a decrease in the cost of production, except as the decline in pig tin has reduced the cost of making tin plate and the decline in spelter has reduced the cost of making galvanized sheets. Certainly as regards black sheets there has been no reduction in the cost of steel to the sheet mill. The Carnegie sheet bar price shows a decline of $2, from $31 to $29, but there is undelivered tonnage which will have to be taken out at $31, and there are stocks of $31 steel at some of the mills. As to steel made by other steel mills, the fact is that scarcely any was sold at $31, the great bulk of the sales having been made when the market was $30. Accordingly the reduction in the steel price can hardly be considered to average more than a dollar a ton. The net cost to the sheet or tin plate mill is not reduced, however, if regard be had to scrap, since sheet scrap has declined $8 or $9 a ton at mill, and the sheet and tin plate mills produce on an average about one ton of scrap to every eight tons of steel received.

There has been a feeling throughout the sheet buying trade that a reduction should be made, and the reductions in black sheets, blue annealed sheets, and

painted corrugated roofing, are a tribute to that feeling.

With the coated product the case is different. Tin has undergone a remarkable decline, from 49½ cents in the middle of May, 1906, and a secondary high point of 43½ cents in June, 1907, to less than 27 cents in the past week, the lowest price since July, 1904. As usual, opinion is divided as to whether pig tin will advance tomorrow, next week or next month. Among tin plate mills, however, the feeling is decidedly that there will be an advance, as they know that the consumption in tin plate making will be large and they believe the speculative sentiment has been too pessimistic to apprehend this prospect. Spelter had a remarkable decline also, but has already regained part of the decline.

While producers do not expect any great improvement in the demand for sheets at an early date, there is the best reason for expecting a great increase in tin plate demand. This trade stands by itself; men must eat, and nature has decreed that the crops will spoil if they are not put into the cans on schedule time. Ordinarily the demand against the spring crops is such that the entire capacity of the mills during February and March is insufficient to supply it, and a large part of the mill activity in November and December is for the accumulation of stocks, Jan. 1 usually seeing stocks of about 1,500,000 boxes. This season there has been no accumulation whatever; the buyers refused to obligate themselves and the mills would not assume such a burden in the circumstances.

A pronounced start towards much greater tin plate production was made this week by the leading interest, which has just about doubled the number of its tin mills in operation. For two months it had operated about 50 tin mills, in five plants. This week it is operating 99, including the two New Kensington plants, with eight mills each; Monessen, with 25; Morgantown, with 10; Laughlin, with 23; Crescent, with six; 10 of the 30 mills at the Shenango works; six of the seven at Chester, and three of the seven at Cambridge. This 99, however, is less than half the average number with which it has started the new year in the past few years. There is every prospect that additional mills will be started next week and the week after, both by the leading interest and by the independents.

The fact that most of the canning crops were short last year is favorable to the industry this year. While the production of tin and terne plate in 1905 was 577,562 gross tons, a gain of more than 80,000 tons over the best previous years, the output in 1907 has been estimated at only half a million tons. The drop of some 70,000 tons is almost equalled by the amount of stocks which are usually made up towards the close of the year, thus showing some decrease in the actual consumption, and leaving nothing for the natural annual increase, so that with prospects of a heavier pack this year, and 50,000 to 70,000 tons of stocks not accumulated, as usual, the tin plate outlook is excellent. Unfortunately this is not necessarily a good augury for other branches of the steel trade; it is a tradition that the tin mills frequently thrive best when other industries suffer.

It is less than 17 years since the McKinley protective duty was put on tin plate, 2.2 cents a pound, effective July 1, 1891. Prior to that time there was no American tin plate industry. Owing to political uncertainties and the delays incident to the starting of a new industry, involving many complicated and not well understood processes, it was not until the calendar year 1895 that production attained the dignity of six figures, reaching 113,666 gross tons in that year. Whether compared with this tonnage in 1895, or with no tonnage at all prior to 1891, the present rate of production of over half a million tons a year, valued at $40,000,000 or $50,000,000, is a remarkable feat.

Large Contract Closed.—The California Fruit Canners' association has closed a contract with the American Can Co. for 300,000,000 cans to be delivered during the next five years. The tin plate will be furnished by the American Sheet & Tin Plate Co., and will make 5,000 carloads in being shipped to California, where it will be worked into cans. Each carload of tinplate, when worked into cans, will fill four cars and each car load of empty cans will make five car loads of canned goods, or a total of 100,000 car loads. The California Fruit Canners' association operates 32 canneries in California.

INDUSTRIAL NOTES

From Chicago and Vicinity—Railroad Inquiries for Tools.

Office of THE IRON TRADE REVIEW,
1362 Monadnock Block,
Chicago, Jan. 7.

The General Electric Co. reports encouraging signs of returning confidence in business. During the past week contracts were closed with the Illinois Steel Co. for 1,700 horsepower in induction motors for the coke oven plant at Joliet and with the Indiana Steel Co. for nine 100-kilowatt transformers for Gary.

The American Association for the Advancement of Science met at the Auditorium Annex, Chicago, during the week of Dec. 29 and many subjects of broad scientific interest were presented and discussed. A pleasing feature of the closing banquet was the honoring of Dr. A. A. Michelson who was this year awarded the Nobel prize for scientists. A large attendance of eminent educators and scientists made the meeting a very successful one.

The Chicago, Milwaukee & St. Paul railroad is in the market for the following list of tools: One 5-spindle boring machine with two universal spindles, one No. 4 patent band scroll and saw, one swing saw to carry a 24-inch saw, one 1-spindle horizontal radial car borer, two 1-spindle universal horizontal boring machines, one large automatic car gainer, one No. 8 extra range horizontal hollow chisel mortiser, two 4-cylinder horizontal boring machines, one universal wood worker, one planer and sizer to dress timber, one 4-spindle gang boring machine (10-foot bed), one shaper, one improved variety saw, one tool grinder, one automatic band saw setting machine, one 30-inch single surface planer with sectional feed roll, one 60-inch, 3-drum sander, one 20-inch jointer, one universal double-circular saw, one variety tip-table saw bench, one jig saw, one 10-inch outside molder, one 12-inch jointer, one rip saw, one cut-off saw and one extra 12-inch cut-off saw, two shapers, one turning lathe (18-inch swing to turn lengths up to 8 feet), one 4-inch 4-side molder, one automatic circular saw sharpener, one hand grinding machine and one Beach patent drill chuck.

W. M. Baxter, vice president, has opened an office in Chicago at 1538 Monadnock block for the Republic Railway Appliance Co. of St. Louis, Mo.

The N. & W. shops at Williamson, W. Va., and Portsmouth, O., and the C. & O. shops at Huntington, W. Va., and Russell, Ky., have curtailed their working forces materially during the past few weeks. The Huntington shops were closed two days last week while the inventory was being taken.

LOW MARK IN DECEMBER IRON MAKE.

The low mark of the year in monthly blast furnace production in the United States was touched in December, when a total of 1,234,733 tons of coke and anthracite pig iron were made. This compares with a total of 1,820,558 tons in November, a loss of 585,825 tons, and with 2,359,690 tons in October, a loss of 1,124,957 tons.

The capacity in blast at the end of the year reflects the decisive measures of curtailment adopted by operators at the prospect of a declining market. The active capacity at the end of December was 154 stacks, against 226 active stacks Nov. 30, a decrease of 72 stacks, and against 314 active stacks, Oct. 31, a decrease of 160 stacks or a loss of 51 per cent. The average daily capacity throughout December was 39,830 tons, compared with 60,685 tons in November and 76,119 tons in October.

January's similarly small output is foreshadowed by the average daily capacity of the furnaces in blast Dec. 31, which was 31,814 tons. As a number of additional stacks were added to the idle capacity upon or immediately after the first of the year, the making of pig iron is started in 1908 under greater contrasted conditions to those prevailing at the beginning of 1907.

December pig iron make as to its ultimate consumption, whether by sale in the open market or by its use in the mills of the producer shows 536,149 tons of merchant and 682,316 tons of non-merchant output.

DECEMBER FURNACE REPORT.

STATE	NO. OF STACKS	NO. IN BLAST ON LAST DAY OF MONTH		PERCENTAGE OF TOTAL POSSIBLE OUTPUT MADE		AV. DAILY CAPACITY IN BLAST LAST DAY OF MONTH	ACTUAL TONNAGE MADE		TOTALS	
		DEC.	NOV.				MERCHANT	NON-MERCHANT	DEC.	NOV.
Pennsylvania	157	71	96	52.3		15,580	191,508	369,971	553,087	802,081
Ohio	61	16	32	47.0		3,346	120,396	62,041	182,437	361,921
Alabama	46	18	20	43.7		2,830	63,951	34,001	97,952	118,389
Virginia	22	7	13	45.7		642	28,635	———	28,635	37,591
New York	24	9	12	45.6		2,250	43,795	40,973	84,768	109,813
New Jersey	10	5	5	50.0		821	22,555	———	22,555	24,073
Illinois	24	11	16	54.3		3,723	11,100	123,462	134,562	183,864
Tennessee	18	8	12							
West Virginia	4	0	2	47.4		762	32,783	1,066	33,849	60,573
Kentucky	7	1	4							
Maryland	4	1	3							
Wisconsin	6	1	3							
Colorado	6	3	3	48.2		1,642	18,354	50,802	69,156	84,795
Indiana	1	1	1							
Georgia	2	0	0							
Texas	2	0	0							
Minnesota	1	1	1	42.3		218	11,464	———	11,464	16,994
Michigan	2	1	2							
Missouri	1	0	1							
Spiegel—All states									6,612	12,916
Ferro—All states									9,656	14,214
Totals	398	154	226	——		31,814	536,149	682,316	1,234,733	1,820,558

Furnace B of the Iroquois Iron Co., South Chicago, was blown out Dec. 15.

Furnace A of the Wisconsin Steel Co., Chicago, was banked Jan. 1.

The Ashland Iron & Mining Co., Ashland, Ky., banked its No. 2 Ashland stack Dec. 29.

The Maryland Steel Co., Sparrows Point, Md., banked its stacks C and D Dec. 22. B stack was out the entire month.

The Missouri furnace of the St. Louis Blast Furnace Co., St. Louis, went out of blast Dec. 30 for relining.

The stack of the Burden Iron Co., Troy, N. Y., has gone out of blast.

The Lackawanna Steel Co., Buffalo, banked Lackawanna furnace No. 2 Dec. 24, and Lackawanna furnace No. 1 Dec. 27.

The Ella furnace of Pickands, Mather & Co., Cleveland, was blown out Dec. 31.

All of the Hazelton stacks of the Republic Iron & Steel Co. were idle at the end of December, Nos. 2 and 3 having gone out during the month.

Anna furnace of the Struthers Furnace Co., Cleveland, suspended operations Dec. 15.

One of the Wellston stacks of the Wellston Steel & Iron Co., Wellston, O., was idle 24 days in December.

Sheridan furnace of the Berkshire Iron Works, Sheridan, Pa., went out of blast for repairs Dec. 17.

The Bethlehem Steel Co., South Bethlehem, Pa., blew out its A furnace Dec. 21, and its C furnace Dec. 7.

The Topton furnace of the Empire Steel & Iron Co., Catasauqua, Pa., went out of blast Dec. 11.

Rebecca furnace of the Kittanning Iron & Steel Co., Kittanning, Pa., went out of blast Dec. 19.

Nittany furnace of the Nittany Iron Co., Bellefonte, Pa., went out of blast Dec. 31 for an indefinite period.

One of the Lebanon, Pa., furnaces of the Pennsylvania Steel Co., was banked in December.

One of the furnaces of the Bon Air Coal & Iron Co., Nashville, Tenn., went out of blast Dec. 12.

The Goodrich furnace of the Standard Iron Co., Nashville, Tenn., went out of blast Dec. 22, and it is expected to be idle for a period less than three months for relining and repairing. The furnace has been run continuously on the present lining since the latter part of March, 1904, and during that time it was not banked in all more than two weeks. In addition to the relining, the C. W Hunt system is being installed, the mantle raised and the capacity of the furnace somewhat increased.

BLAST FURNACE NOTES.

Holt furnace of the Central Iron & Coal Co., Holt, Ala., went out of blast Jan. 1 for relining.

The E. & G. Brooke Iron Co., Birdsboro, Pa., blew out one of its stacks Jan. 1, leaving one in blast.

Watts furnace at Middlesboro, Ky., of the Virginia Iron, Coal & Coke Co., is out of blast after having been operated 23 days in December.

None of the furnaces of the South-

CORPORATION FIXES BASIS FOR PROFIT-SHARING.

(Special Telegram.)

New York, Jan. 8—It is announced at the offices of the United States Steel Corporation that a price of $87.50 has been fixed at which employes can subscribe for the preferred stock under the profit-sharing plan. This compares with $102 last year. The question of paying a bonus to those employes already holding stock has not yet been decided.

PIG IRON OUTPUT INCREASES IN 1907.

In the calendar year 1907 there was produced by the blast furnaces of the United States a grand total of 25,299,732 tons of coke and anthracite pig iron according to the complete returns made to THE IRON TRADE REVIEW. This make compares with a total tonnage of 24,874,184 in 1906, or a net gain of 425,548 tons. With annual charcoal iron about 450,000 tons, the total all pig iron output of the country in 1907 was approximately 25,750,000 tons.

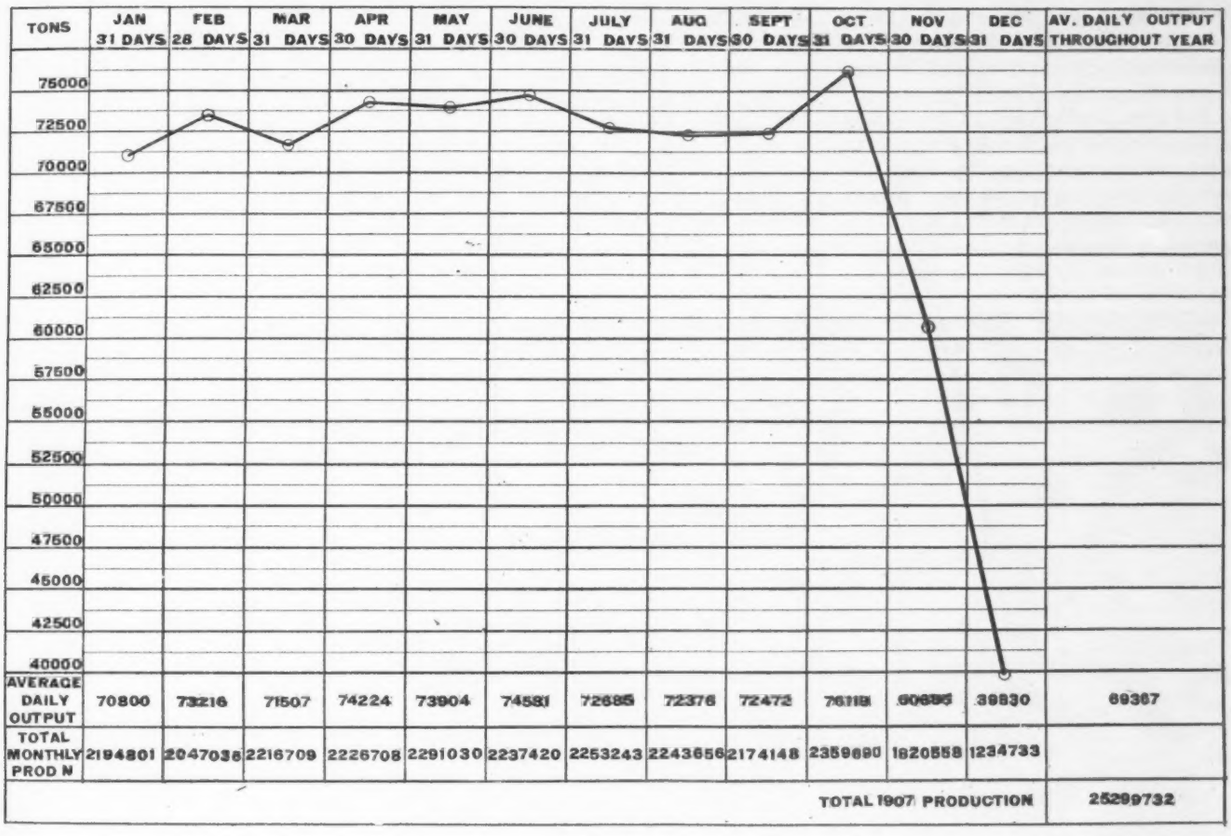
Pig iron making began in 1907 at a high-record pace which increased as the year advanced and was then maintained without material variation for a period of 10 months. In March, a condition of floods in the Pittsburg district forced the banking of numerous stacks and diminished production accordingly. The first appreciable slump in the rate of output, however, came in November with the depression that fell upon all branches of the iron and steel industry and this grew even more marked in December, bringing the year, so auspiciously begun, to a close, characterized by a minimum production. In November and December the combined make was but 3,064,291 tons or about 69 per cent of the average production in two of the preceding 10 months.

The extent of the decline in pig iron make produced by the stagnation of business is clearly shown by a comparison of the output of the year by halves as follows:

	1907.	1906.	Change.
First half..	13,213,604	12,374,528	839,076 gain
Second half.	12,086,128	12,499,656	413,528 loss
	25,299,732	24,874,184	425,548 gain

The hardest driving of furnaces was witnessed in October, when operators on the eve of blowing out their stacks because of the falling off of demand, forced a make of 2,359,690, the highest figure attained in a single month in the history of pig iron smelting in the United States.

The accompanying table in units of days conveys the decided trend of fluctuations. The unit of average daily make is selected for comparison rather than months because of its being an equal period of duration throughout the year, thus exactly displaying any variation of tonnage.



TONS	JAN 31 DAYS	FEB 28 DAYS	MAR 31 DAYS	APR 30 DAYS	MAY 31 DAYS	JUNE 30 DAYS	JULY 31 DAYS	AUG 31 DAYS	SEPT 30 DAYS	OCT 31 DAYS	NOV 30 DAYS	DEC 31 DAYS	AV. DAILY OUTPUT THROUGHOUT YEAR
AVERAGE DAILY OUTPUT	70800	73216	71507	74224	73904	74581	72685	72376	72472	76119	60695	39830	69367
TOTAL MONTHLY PROD N	2194801	2047038	2216709	2226708	2291030	2237420	2253243	2243656	2174148	2359690	1820858	1234733	
											TOTAL 1907 PRODUCTION		25299732

The Bird furnace of the Bird Iron Co., Ironton, O., was banked Dec. 1.

BETTER OUTLOOK

For Plant Resumptions in the Hanging Rock District.

(Special Correspondence.)

Ironton, O., Jan. 7.—The resumption this week of the steel plant, rod mill and furnaces at Ashland, Ky., and the preparations for the immediate operation of Sarah furnace here, has given some semblance of renewed activity in the iron industries of this section. The steel plant at Portsmouth did not, as had been anticipated, resume the first of the week, but it is expected to fire up in the near future.

George H. Barney, who is employed as a finisher in the rod mill department of the Ashland Steel Co., has recently invented an instantaneous automatic steam and gas valve and has been in Washington to have it patented.

The Portsmouth Steel Co. has had an extra force of bricklayers at work putting the sacking pits in shape for operation at an early date, orders having been issued by President Glessner of Wheeling to rush the work of repairs.

OBITUARIES.

Robert W. Gardner, president and founder of the Gardner Governor Co., Quincy, Ill., and a well known inventor and philanthropist, died Dec. 21, at the age of 76. He was a member of several international scientific societies.

George H. Reynolds died at his home, Spring Manor, Conn., Jan. 3. He was superintendent and general manager of the Mystic Iron Works, Mystic, Conn., and at one time was consulting engineer of the Pneumatic Dynamite Gun Co., of New York. Many of the dynamite guns were built under his patents and he superintended the construction of the dynamite cruiser Vesuvius. He was a brother of Edwin Reynolds, designer of the Reynolds-Corliss engine, and leaves a wife and two sons.

Harrison Loring, one of the pioneer iron steamship builders of the country, died Dec. 26 at his home in South Boston, following an operation for appendicitis. He was 85 years old. Mr. Loring opened a machine and boiler shop in South Boston, in 1847. Ten years later he began the construction of iron steamships and built many of this class of vessels for the government. The firm of Harrison Loring & Co. also built many merchant craft and erected the steel framework for various lighthouses along the Atlantic coast.

Robert B. Brown, aged 61 years, a well-known resident of Pittsburg, died Jan. 2 at his home in that city from heart failure resulting from a slight attack of pneumonia. Mr. Brown was educated in private schools, at Western University of Pennsylvania, and at the Sheffield Scientific School of Yale University. He was interested in numerous enterprises, principal among which the supplying of natural gas to the city. He was organizer of the Duquesne Steel Co., along with Joshua Rhodes, W. G. and D. E. Park and others, and built the most modern mill of its day at Munhall, Pa., which was later absorbed by the Carnegie Steel Co.

Leopold Vilsack, a foremost business man and capitalist of Pittsburg, died at the family home in that city Dec. 26 after an extended illness. His age was 70 years, of which 50 years has been spent by him as a leading figure in the commercial circles of Pittsburg and Allegheney. He was intimately associated with many and varied interests in these cities. In the iron and steel line, he was president of the Epping-Carpenter Co., manufacturer of pumping machinery, president and controlling stockholder in the Vilsack-Martin Co., manufacturer of ornamental iron work, and was one of the organizers of the Aliquippa Steel Co., now a constituent of the Crucible Steel Co. of America, holding the controlling interest in the company at the time of the transfer.

Isaac Reese, a pioneer iron manufacturer and more recently identified with the fire brick industry, died Jan. 1 at his home in Pittsburg, death being due to a nervous shock resulting from a fall from a street car a few weeks before. Mr. Reese was 87 years of age. He came with his parents to this country from Wales in 1832, and after the family had settled at Pittsburg, William Reese, the father, became one of the best known iron men in that city during the middle of the last century. His eldest sons, Isaac and Jacob, became associated with him and attained prominence in the building of blast furnaces. Later Isaac Reese took up the manufacture of fire brick and his sons were interested with him in the firm of Isaac Reese & Sons. Plants were established at Osceola Mills, Pa., Manorville, Pa., and near Kittanning, Pa. When the consolidation of various fire brick interests was effected several years ago, Mr. Reese retired from active business life.

Alexander W. Slocum, well known throughout the country, particularly in railway and manufacturing circles, died at his home in Pittsburg, Dec. 31. Mr. Slocum was born in Washington county, N. Y., 44 years ago, and received his education in the public schools of New York City and Columbia University. In his life he was connected with many large car wheel manufacturers throughout the United States and Europe. In 1896 he was sent by a Buffalo company to superintend the erection and put in operation a car wheel plant at Budapest, Austria, and one in Leobras, Germany. In 1900, with his brother, Charles V. Slocum, of Pittsburg, he was instrumental in founding and developing the Pennsylvania Car Wheel Co., of McKees Rock, Pa., which was later absorbed by the Schoen Pressed Steel Car Co. He was one of the promoters of the Keystone Car Wheel Co., which later became the National Car Wheel Co., Pittsburg. In 1906 he made a contract with the Dixon Car Wheel Co., Houston, Tex., to build and put in operation a car wheel foundry at that place, and this he completed about 60 days ago. Mr. Slocum was a member and former president of the Pittsburg Foundrymen's Association, a member of the Pittsburg Railway Club, the Engineers' Society of Western Pennsylvania and other organizations.

PERSONALS.

J. C. Miller, formerly sales agent of the Columbus Iron & Steel Co., Columbus, O., has been elected secretary of that company.

John C. Bannister has been appointed manager of the Western Tube Co., Kewanee, Ill., succeeding the late A. M. Hewlett. Mr. Bannister was formerly chief engineer of the Kewanee plant.

L. M. Bowers has been elected vice president of the Colorado Fuel & Iron Co. Mr. Bowers was recently added to the directorate of the company, succeeding Col. R. C. Clowry, and represents the Rockefeller interests of the company.

Forest E. Green, assistant purchasing agent of the Ralston Steel Car Co., Columbus, O., has been promoted to purchasing agent, vice Lucian C. Brown, who has been made manager of the new eastern office at New York, which the company opened the first of the year.

Fred W. Sack, vice president of the Bassett-Presley Co., Cleveland, returned to Cleveland recently, from Chicago, having successfully recovered from a most severe and remarkable operation. The successful outcome was in a large measure attributable to the personal fortitude and endurance of Mr. Sack and the permanent restoration of his health is assured.

George Baker, general manager of sales in Chicago for the Illinois and Carnegie Steel companies, has been appointed manager of sales in the same district for the Tennessee Coal, Iron & Railroad Co. A. H. Carpenter, who formerly had charge of the Chicago sales office of the southern company before its selling arrangement with the Republic Iron and Steel Co. will act in the capacity of assistant to Mr. Baker in the sale of the company's output of foundry pig iron.

Chas. E. Sargent, who for the past seven years has been manager of the Sargent Engineering Co., Chicago, has resigned to accept the position of chief engineer and manager of the gas engine department of the Wisconsin Engine Co., Corliss, Wis., builders of high grade Corliss engines, and which will now build the Sargent complete expansion gas engine, the invention of Mr. Sargent. C. E. Beck, who has been assistant manager and engineer of the Sargent Engineering Co., which has always made a specialty of designing and testing internal combustion engines and producers, will succeed Mr. Sargent. The Sargent Engineering Co. offices are in the Plymouth building, Chicago.

THE ELECTRICALLY-DRIVEN 30-INCH UNIVERSAL PLATE MILL OF THE ILLINOIS STEEL CO.

In the issue of THE IRON TRADE REVIEW of July 5, 1906, a preliminary description of the proposed 30-inch universal plate mill and No. 2 24-inch rerolling rail mill to be built at the South works of the Illinois Steel Co. was published, together with ground plans. These mills have been but recently completed and are now in operation. Both employ electrical driving mechanisms to a greater degree than has been attempted heretofore, except for instances in Germany. Especially is this true in the case of the universal plate mill—the first universal mill, by the way, in the Chicago district—for there a reversible mill is being driven by electric motors for the first time in America. This drive is the important innovation in this plate mill, though numerous other features of advantage have been attained in the design and layout which is shown in Fig. 2.

In company with the electrical control and drive, two other features of the plate mill are particularly noticeable—the small number of men required for operating the mill and the adequacy of the space allotted for the lay-out of the plant. A crew of eight men constitutes all the labor necessary for the handling of the rolls and hot beds, four men for each. At the rolls are stationed a roller, one man for the top and bottom rolls, one for the side rolls and an operating engineer, who from an adjacent pulpit completely controls electrically the direction of the rotation and the speed of the rolls and tables. On the hot beds, one man is required on each side to look after the mechanical manipulation of the plates, and two men mark up the plates with the necessary specifications and labels. The size of the mill building, 83 feet wide by 616 feet long, is ample to permit a free and direct continuity of the successive operations and to avoid the possibility or appearance of congestion.

The electrical installation is not only interesting as the first application of its kind, but also in that the units employed are the largest that have ever been used. The design and specifications worked out to meet the requirements of this mill are a collaboration by the engineering department of the Illinois Steel Co., under supervision of E. B. Clark, with the Westinghouse Electric & Mfg. Co., which built all of the electrical apparatus.

The plate mill is of the two-high reversing type shown in Fig. 1, and general plan of the rolls and the driving unit complete is shown in Fig. 3. The driving unit consists of a direct-current, direct-connected motor which derives its power from an equalizer set. The electrical equipment is located in a well-lighted room separated by a wall partition from the mill room proper and provided with a roof that may be removed in sections;

FIG. 1—30-INCH UNIVERSAL PLATE MILL, ILLINOIS STEEL CO., SOUTH CHICAGO.

thus protection is afforded against the heat and dust from the mill to a great extent. A 30-ton Whiting overhead traveling crane spans the mill building and the runways are high enough to allow the crane to pass over the motor room. By removing a few sections of the motor room roof the various machines can be reached by the crane should its services be required.

Referring to Fig. 3, the equalizer set is composed of an alternating current motor A, the fly wheel B, and the direct-current generator C. The direct-current motor D is connected by a flange coupling E to the driving spindle F, which drives the pinion shaft G by means of loose box couplings or muffs and a short piece of shaft or wobbler. The pinions are mounted in a suitable housing and each pinion shaft is connected through muffs or wobblers to a horizontal roll. A pinion which meshes into the upper roll pinion drives two horizontal shafts which extend to the outside of the mill housing. These shafts carry the bevel pinions which drive the vertical rolls—two of which are located on each side of the horizontal rolls.

Until a comparatively recent period there have been very few practical data available for determining the amount of power required in rolling mill service, and this has been the principal difficulty in applying electricity to this class of work. All that could be done was to select a motor having a maximum torque equal to that generated by the steam engine which would have been selected, though just what normal capacity the machine should have was an open question. The first experiments were made on a non-reversing mill and by carefully indicating the engine, taking observations of the fly wheel speed, the nature of the material worked and the dimensions of the sectional area affected, the average horsepower required for the reduction of a given weight of material was determined.

Using these data as a basis the power required by a three-high, non-reversing mill for any desired condition of rolling could be closely approximated. The application of motors to this class of service does not offer any very serious problems; for by supplying considerable fly wheel effect in the system and providing a motor with a drooping speed characteristic, the heavy and rapidly fluctuating loads can be equalized and the power drawn from the line reduced to a fairly uniform value. The service required of the controller is light, the main function being to start the motor, though in some cases it is necessary to provide automatic means for reducing the speed during the heavy loads.

The problems, however, presented to

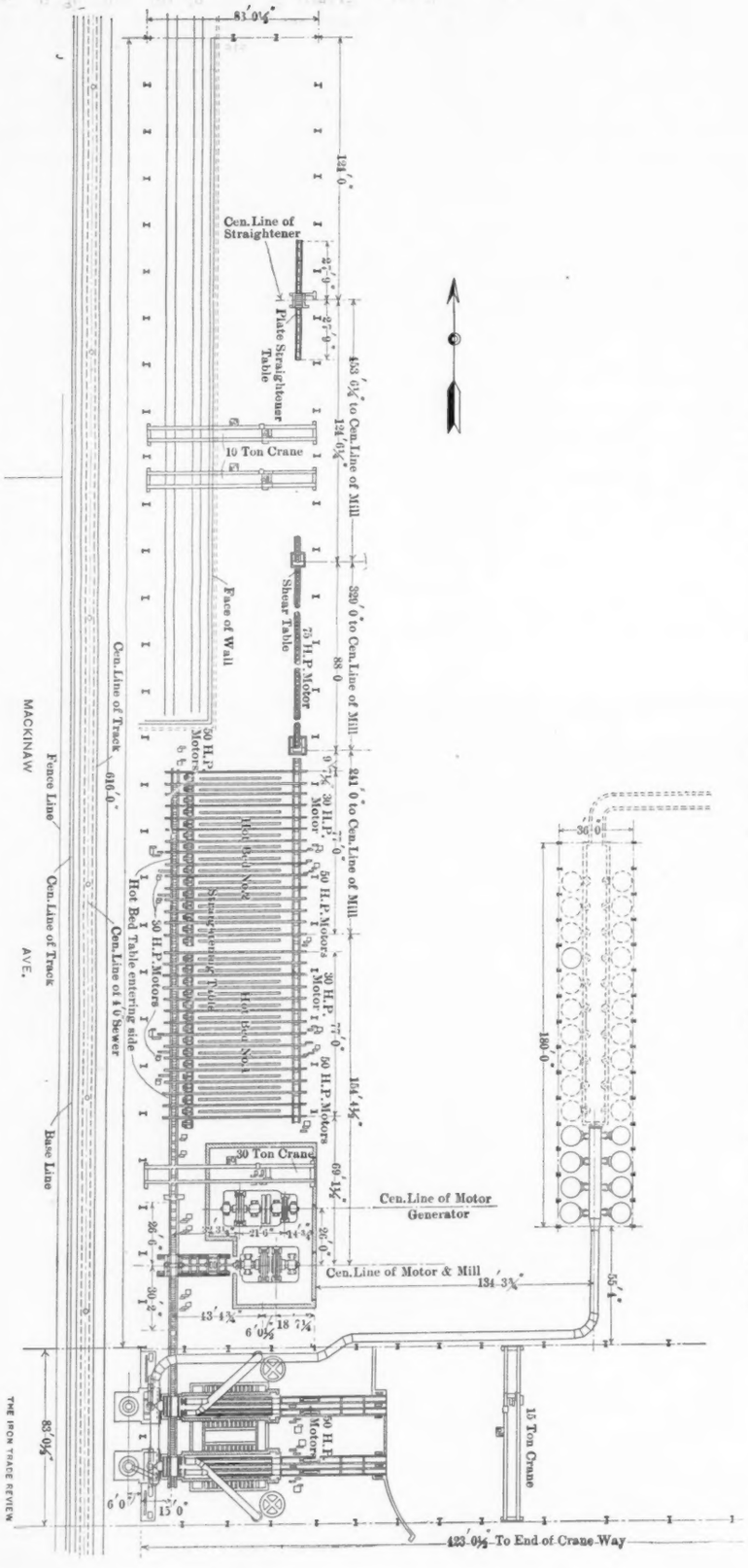


FIG. 2—GENERAL LAYOUT OF 30-INCH UNIVERSAL PLATE MILL OF THE ILLINOIS STEEL CO. AT SOUTH CHICAGO.

the electrical engineer by the heavy reversing mill are much more complicated.

(1) The units required are of a very much larger capacity.

(2) The direct application of a fly wheel to the roll shaft and the operation of the motor direct from the power station are not practical owing to the rapid acceleration, retardation and reversing necessary in this class of service.

In this particular case it would have been necessary to install apparatus capable of supplying a maximum demand of 10,000 horsepower and the regulation of the power machines would have been such a serious question that gas engine driven units could not have been considered.

It is necessary to equalize the power requirements from the central station in order to make an electrical proposition feasible. The control apparatus for the mill motor must be of simple design, easy to operate and must be capable of producing the required changes of speed and direction of rotation very rapidly. The great advantages afforded in transmission by high voltage alternating current are in general sufficient to warrant a selection of this class of station machines.

At the present time the power station of the South works consists of the following alternating-current, 2,200-volt, three-phase, 3,000-alternation machines:

Three 2,000-kilowatt generators, direct-connected to steam engines; one 2,000-kilowatt generator, direct-connected to steam turbines; and additions are being made which will include four 2,000-kilowatt generators, direct-connected to gas engines which will use blast furnace gas.

The power requirements for reversing mill work have received a great deal of attention during the last few years. Continuous indicator diagrams were taken from reversing engines and speed variations were noted. The moment of inertia of the system and therefore its kinetic energy at any given speed was calculated; and the power required for acceleration determined. From the data thus obtained a torque curve was plotted, giving the torque actually required at the roll surface for the various passes, or in other words, for a given reduction of section, making liberal allowance for friction. Certain corrections are made in using these data, as the power required during the latter part of the cycle for a given reduction increases on account of the diminished temperature of the material; but the reduction in the last few passes is small, and, as shown in the load curve hereafter referred to, the minimum and maximum power required for this portion of the cycle is not very large as compared to the load during the breaking down period; and consequently the average horsepower required will not be greatly affected by the finishing temperature conditions.

An analysis of the requirements for the driving unit in reversing mill work is best made by means of speed, torque and horsepower curves. It is necessary to decide on the number of passes in which a given reduction of section is to be effected and this naturally depends on the power available and the amount of work it is desired to put into the finished product. Certain assumptions have to be made regarding the methods of rolling and generally these are: (1) that the acceleration from zero to full speed takes place in a certain time, varying from two to five seconds; (2) that the material enters the rolls when they are at approximately half speed; (3) that current is shut off from the motor and the rolling continued by the kinetic energy of the moving parts so that the material leaves the rolls at half speed; (4) an interval of time selected for handling

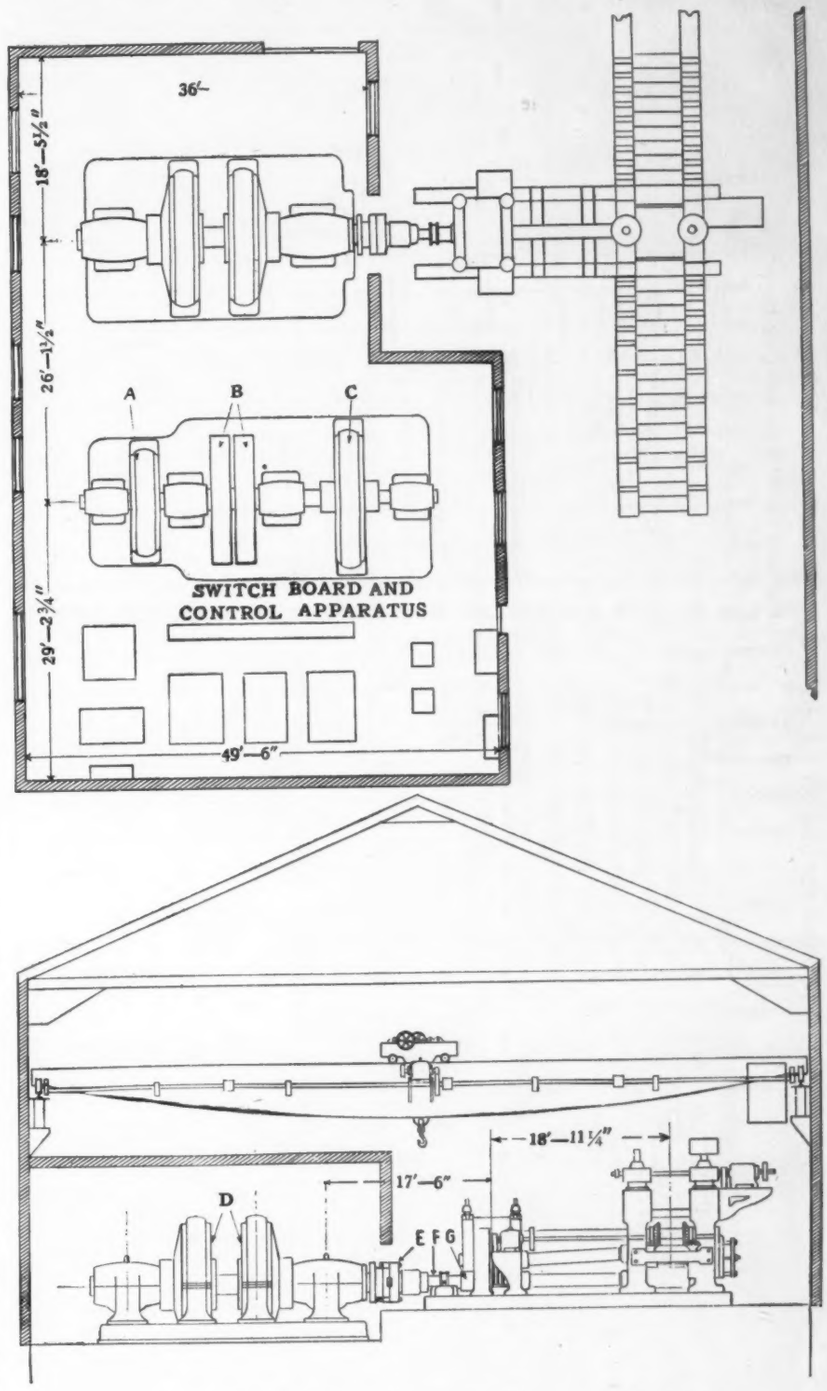


FIG. 3—ARRANGEMENT OF ELECTRICAL UNITS AND CONTROL.

the material between passes which varies from two to three seconds. A practical rolling speed is selected and, having settled the above matters, a speed curve is constructed. The field data of power requirements that have been obtained are generally figured to derive the foot-pounds torque at the roll surface to give three curves; A representing the speed curve, B the torque curve and C the horsepower curve. The data upon which these curves were based were obtained from steam engine driven units and the time periods were carefully checked from actual operating observation. It is to be noted that the speed increases the rate of 100 revolutions per minute per second, or a full reversal from the maximum speed in one direction to any speed in the opposite direction is made in three seconds. As noted above, however, such conditions of operation are not required in actual practice.

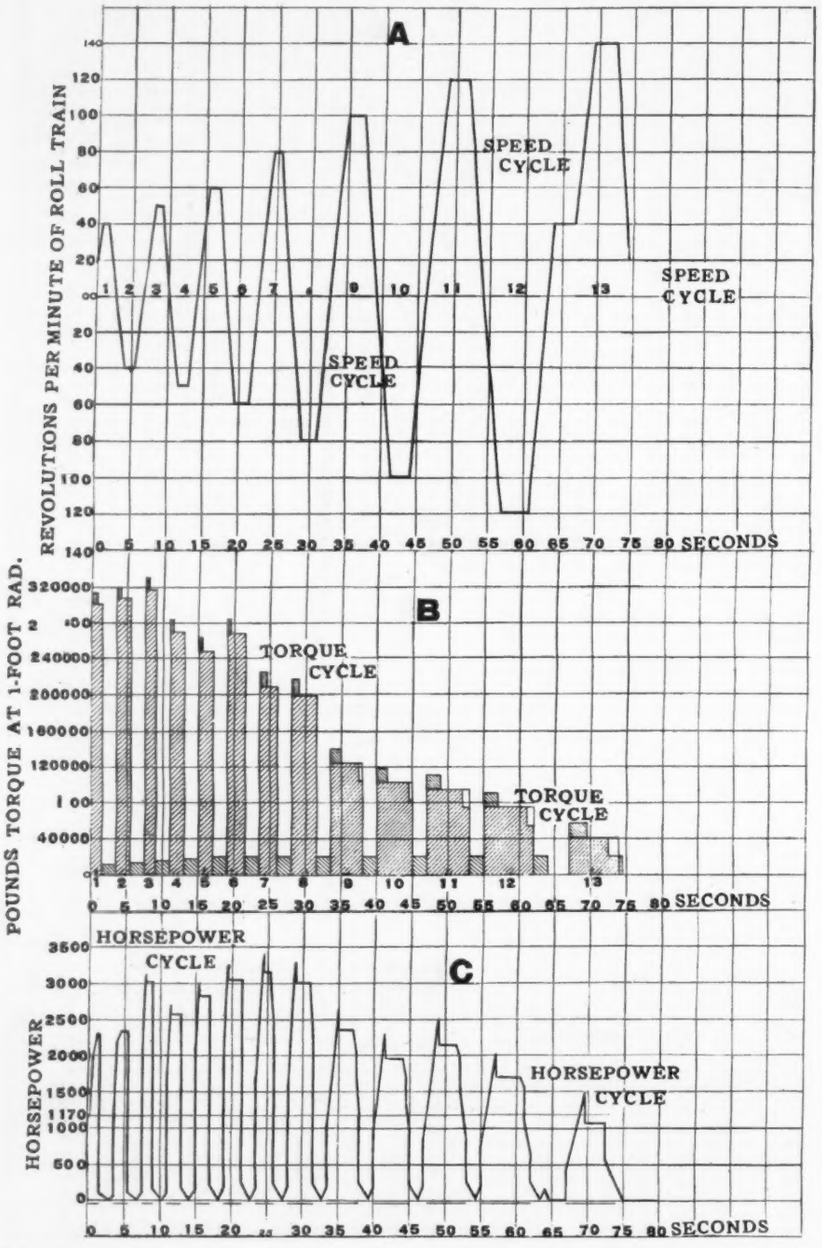


FIG. 4—SPEED, TORQUE AND HORSEPOWER CURVES, SHOWING REQUIREMENTS OF 30-INCH REVERSIBLE MILL.

a certain reduction of section and with the number of passes decided with a change of section per pass, the required torque curve is next plotted. From these two curves a horsepower curve can easily be calculated.

Fig. 4 gives the requirements for the 30-inch plate mill in the form of these throughout the cycle while the torque decreases with the result that the power required during the various passes is fairly uniform. The speed of the mill motor is varied from zero to 150 revolutions per minute in one direction and from this speed to 150 revolutions in the opposite direction. The acceleration is at

The number of passes required to roll the average plate is 13 and the time for one cycle is 75 seconds. This is divided into a working period of 48 seconds and a total interval of rest equal to 27 seconds with an approximate period of two seconds between passes. The horsepower required varies from zero to 3,400, which gives an average for the cycle of 1,170 horsepower.

In the case of the 30-inch mill equipment the various problems as shown by these specification curves have been solved by supplying a direct-current, shunt-wound motor for driving the mill and using an equalizer in the form of a fly wheel type motor-generator set, located electrically between the mill motor and the central station which supplies high voltage alternating current power. The equalizer set operates continuously with relatively slight variation in speed. The field of the mill motor is permanent while that of the shunt-wound motor is variable. With zero current in the generator fields the electromotive force of the armature circuit is zero and no current is supplied to the mill motor, the armature of which is connected permanently by having leads to the armature of the generator. Current is applied to the generator fields first through very high resistance and as this is cut out the field is strengthened and the generator voltage is increased accordingly. The motor speed follows the variation directly and the amount of current which it takes will be governed by the torque required to perform the work. The reversing of the mill motor is accomplished by reversing the current in the generator field circuit which changes the direction of flow of current in the armature circuit of both the generator and motor. Thus the full control of the mill motor is obtained by means of a field rheostat which governs a circuit of less than 150 amperes.

The function of the fly wheel is to convert this varying load into a uniform constant load; consequently the required capacity of the alternating-current motor of the equalizer set (and the power taken from the line) is designated by the average load condition. The three factors to be considered in figuring the fly-wheel capacity are the amount of energy required from the fly wheel, which is usually figured in horsepower-seconds, the percentage drop in speed allowed and the time available for storing up energy in the wheel. By referring to the horse-

power curve, Fig. 4, the amount of energy to be given out by the fly wheel is that shown above the average line and the storing up periods (or periods of rest) are equal to the delivering periods (or periods of work). The drop in speed of the motor-generator set ranges from 10 to 15 per cent for the heaviest passes; and, in case the loads should be greater than is shown, a further drop in speed is obtained, automatically.

The equalizer set is shown in Fig. 5 It is of the 4-bearing type and consists of an alternating-current induction motor, a direct-current generator and a fly wheel located between the two. The revolving elements are mounted on a common shaft 34 feet long and from 18 to 24 inches diameter. The four bearings and the machine frames are arranged on a common bedplate.

The alternating-current motor has a continuous load rating of 1,300 horsepower and will develop a maximum torque three times full load torque. It is of the high frequency type with a wound secondary and is 25-cycle, 2,200-volt, 8-pole, with a synchronous speed of 375 revolutions per minute. No transformers are used, as the voltage of the motor primary is the same as that of the feeder circuit.

The fly-wheel is shown in Fig. 9. It is composed of two units for reasons of manufacture and in order to keep the diameter as small as possible. Even with this arrangement, however, the peripheral speed, which is 250 feet per second, is hardly within a safe limit for a cast steel wheel, and a laminated type was provided. The total weight is 200,000 pounds, the diameter is 13 feet 2 inches, the radius of gyration is 5 feet 2½ inches, and the fly wheel effect is 2,660,000 pounds at one foot radius. The wheel consists of a sheet steel rim and a cast steel spider with double spokes of comparatively small sections, this construction making the wheel more elastic than a single spoke of equal strength. The frame of the spider is machined with dovetail slots and the thin steel sheets are punched in segments with tongues to correspond with the spider rim slots. These segments are assembled with overlapping joints and on the outside are placed heavy one-piece steel end rings, which are clamped to the laminations by means of through bolts, though in reality very little strain comes on these bolts as the thin sheet construction gives a very high slipping resistance with a comparatively light pressure.

To give an idea of the energy stored in this wheel and the efficiency of the motor-generator set, it requires 1,200 kilowatts for a period of five minutes to accelerate it to full speed and the load, running light, is 200 kilowatts.

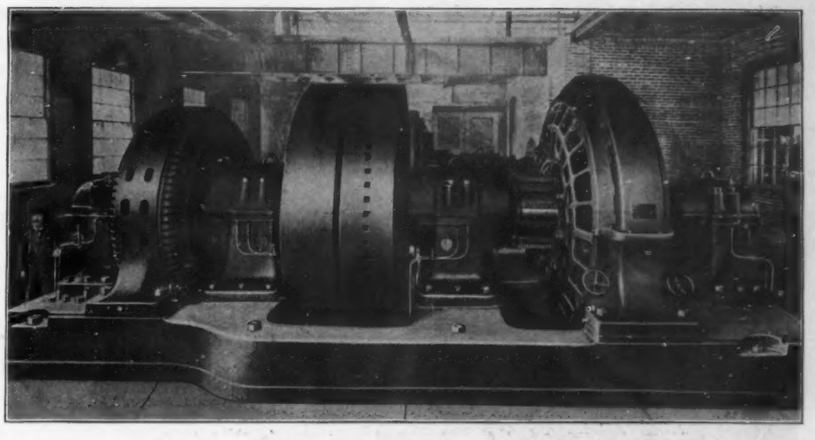


FIG. 5—EQUALIZER SET FOR 30-INCH UNIVERSAL MILL.

The direct-current generator has a continuous rating of 3,000 kilowatts at 600 volts, 375 revolutions per minute and will stand 150 per cent overload without injurious sparking. The speed and direction of rotation of the mill motor is accomplished by varying and reversing the generator fields, which are separately excited from the 220-volt circuit. To facilitate the rapid reversal of the field magnetism the entire magnetic circuit is built up of laminated steel; and is supplied with interpoles (punched with the field laminations), with additional compensating turns, placed in slots in the face of the main poles. The machine is of the double commutator type which provides a liberal capacity for the very heavy current required by the mill motor, and by permitting the use of a large number of bars the voltage between bars is reduced to a low value.

The shaft of the equalizer set is solid and the bearings are of the oil ring type and arranged to take oil from an oiling system. The bottom shells are water jacketed, though the design is very liberal and water cooling is not necessary to insure good operating conditions.

The direct-current mill motor will safely carry a continuous load of 4,000 horsepower at 575 volts and 150 revolutions per minute and will stand a maximum of 10,000 horsepower momentarily. As shown in Fig. 6, it consists of two 2,000 horsepower-units with the armatures mounted on the same shaft and with both motors arranged on a common bedplate, forming a 2-bearing set. The principal reason for the subdivision is to reduce the fly wheel effect which is accomplished by using armatures of small diameters. The power required for acceleration is thereby reduced, which facilitates rapid reversing. The mechanical construction of the field is practically the same as that of the generator, including interpoles and main pole compensating windings, but the armatures have only one commutator each.

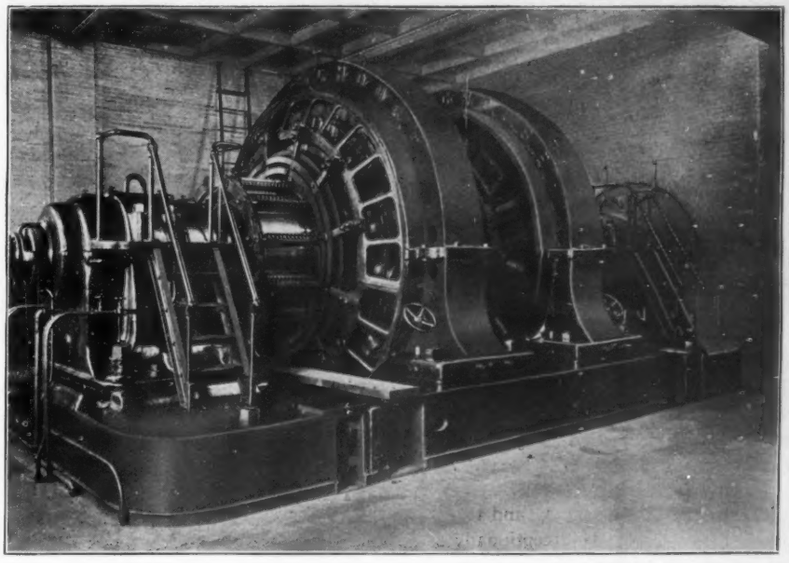


FIG. 6—REVERSIBLE MILL MOTOR SET DRIVING 30-INCH PLATE MILL.

The normal speed of the motor is 100 revolutions per minute and the higher speeds are obtained by means of shunt field control. It will be noted that thus far the maximum speed desired has been approximately 80 revolutions per minute, most of the product being of a comparatively heavy gage. But as operation is carried on, the efficiency of the mill will gradually be increased and the higher speeds thus available will be the means of greatly increasing the output.

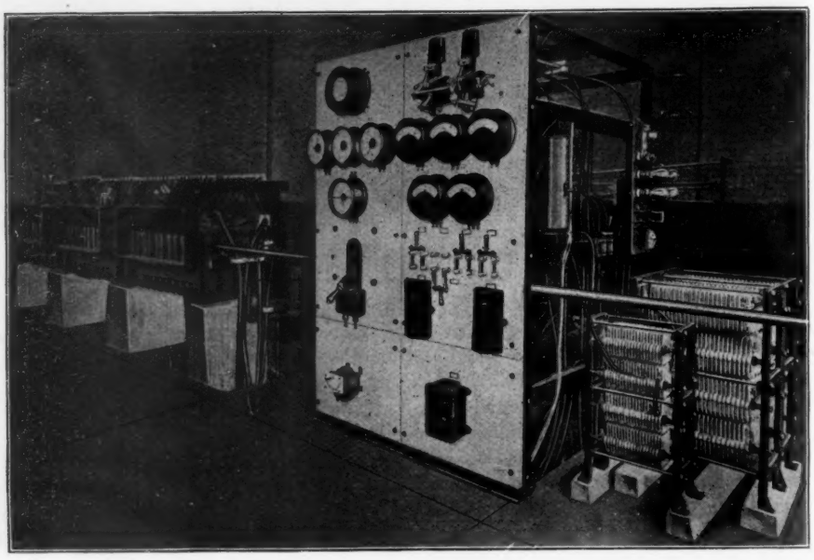


FIG. 7—SWITCHBOARD AND CONTROLLING APPARATUS.

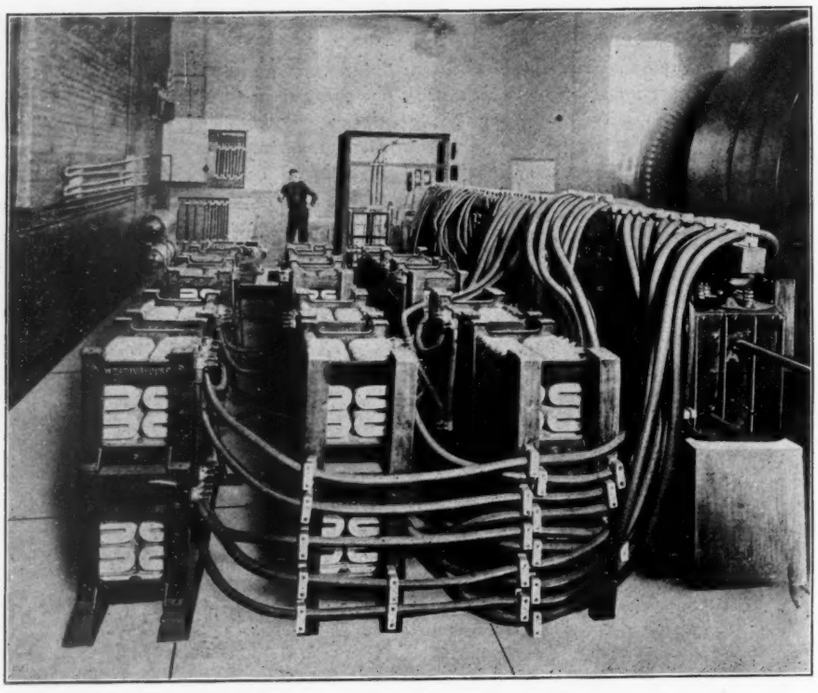


FIG. 8—ADDITIONAL CONTROLLING APPARATUS.

The motor is connected to the mill by means of a flanged coupling and the bearing next to the mill is exceptionally large and well reinforced. It is specially designed to withstand the heavy end thrust that occurs when the mill spindle breaks on a diagonal, thereby tending to lengthen itself between bearings. To provide for the ordinary thrust of the mill, a semi-circular babbitt-faced collar is bolted to the outside surface of the mill end bearing. A babbitt-faced collar provided with adjusting bolts is keyed to the ends of the flange coupling next to the bearing and this acts as the shaft wearing collar. It is split so as to allow easy replacement or repairs.

The general conditions for rolling a 10-inch by ¾-inch universal plate 65 feet long from a 6-inch by 10-inch by 8-foot slab, are as follows: The average alternating current power required was 750 kilowatts with 15 per cent variation above and below this amount and the total peak loads on the direct-current machines ranged from 4,000 to 5,000 amperes. The average time required to roll one plate was two minutes, giving the plate 15 passes.

As explained above, the voltage of the direct-connected generator and consequently the speed of the mill motor is varied from zero to full value in the opposite direction by means of a field rheostat in which the resistance is of the cast grid type mounted externally. This rheostat and also a duplicate which governs the maximum speed of the mill motor, are mounted in the operator's pulpit; and to insure that the motor is always accelerated and reversed with full field, the two rheostats are provided with an interlocking device so that it is necessary to bring the mill motor to its normal speed (100 revolutions per minute) before the motor rheostat can be operated to give the speeds ranging from 100 to 150 revolutions per minute. The main feature of the control is the automatic slip regulator which governs the speed of the motor-generator.

A series of pneumatically-operated switches controlled by means of magnetically operated air valves are used to insert resistance in the secondary circuit of the alternating-current motor, thereby slowing it down during the periods of heavy load and also cutting out resistance, and bringing the speed of the set to normal value during the light load interval.

The air is supplied by a motor-driven compressor; and the current for the magnet circuit of the switches is furnished by a battery connected as a shunt in the compressor motor circuit so that it receives a charging current when this motor is operating. Two current relays which act as opening and closing switches are connected in the magnet control circuit. The relays are governed by current furnished from series transformers in the supply lines to the alternating current motor and consequently the value of the relay current varies directly as the load on the alternating-current motor. During the light load period the current relays close the control circuit to the air operated switches and the secondary resistance is cut out. When the alternating-current motor load exceeds normal value one of the relays lifts and the switches open in regular order cutting in the secondary resistance gradually and reducing the speed of the motor-generator set to such a value that the normal load on the alternating-current motor

plus the power given up by the fly wheel equals the power required by the mill motor. In case of a sudden heavy overload both relays lift and full resistance is inserted in the secondary instantly to give a maximum drop in speed. To meet some conditions of operation it is desired to have the first relay act at a motor load somewhat below normal value and for some work to act at a value above normal. This adjustment is accomplished by means of a compensator in the relay governing circuit. The equalizer set is started by throwing in the oil switch of the supply lines and the acceleration is automatic as explained above.

A line relay, actuated by current from a small series transformer in the alternating-current motor supply line, is connected in the magnet control circuit of the resistance switches and is held normally closed as long as the motor is taking current. When the alternating current fails this relay is opened which breaks the switch control circuit and thereby insures all the resistance being in the secondary circuit when current is again applied to the motor.

To prevent excessive overloads on the direct-current generator either by a too rapid reversing of the mill motor or by supplying a heavy draft to the mill, two overload relays are placed in the circuit connecting the armature of the generator and mill motor. Under the influence of heavy currents these relays operate to open the circuit breaker of the generator and motor field supply line. A centrifugal switch is so arranged on the end of the mill motor shaft that it will open the field circuit of the generator in case of high speed of the motors due to some derangement of the circuits such as an accidental opening of the shunt fields. Under these conditions the electromotive force of the generator will be reduced to zero and consequently no power can be furnished to the mill motor.

The following instruments are provided for the main switchboard: An alternating-current ammeter, voltmeter, power factor meter, indicating wattmeter, and an integrating wattmeter; and for the direct-current machines. Two ammeters, two voltmeters and a speed indicator, all of the indicating type. The latter instrument is operated by means of a small magneto dynamo which is belted to the mill motor shaft. A panel located in the operator pulpit carries an alternating-current ammeter and a speed indicator for the mill motor similar to the one just described. Thus the operator can see at a glance just how hard he is working the mill and at what speed.

This plate mill equipment demonstrates satisfactorily that the most severe conditions of rolling mill work can be met with the electric drive. Gas engines, direct-connected to the mills, have been tried and though with partial success, in most cases it has been found that they do not meet the requirements, owing to their limited overload capacities. Figuring in terms of torque the electric motor meets rolling mill conditions in an ideal way, responding to the demands made upon it to the extent of extreme overloads for a comparatively short time. In every mill there are times when it is found most convenient (if not necessary) to increase the draft or use large stock to secure the desired length of finished material with no change made in the rolling cycle. To meet these conditions it is customary to install gas and steam engines which are much larger than is required for the average work.

The maximum torque that can be exerted by a motor varies from two to three times full load torque, which means that in selecting a motor of electrical strength equal to the strength of the mill the unit does not have to be so large in regard to normal capacity as the engine that would be selected to meet the same conditions. In the case of a gas engine the motor and engine size would be practically in the ratio of one to two to give equal results.

By using motor drive, direct connection can be made with any type of mill. In the majority of cases a simple, non-condensing twin engine is provided for a reversible mill; and with the overhung crank arrangement a gear reduction is necessary in order to connect the engine with the mill driving shaft. This gear reduction seldom exceeds a 1 : 1½ reduction, and though the higher speed engine, which this arrangement permits, reduces the first cost, the efficiency of the mill is less and the upkeep is greater than is obtained by the use of a direct-connected unit.

A particular advantage of the electric drive for mills operating continuously, is that a speed variation ranging as high as 3 : 1 can be obtained economically without the use of mechanical means such as change gears. It is also being recognized that great economies are obtained in developing power by means of gas engines using blast furnace gas; and to ap-

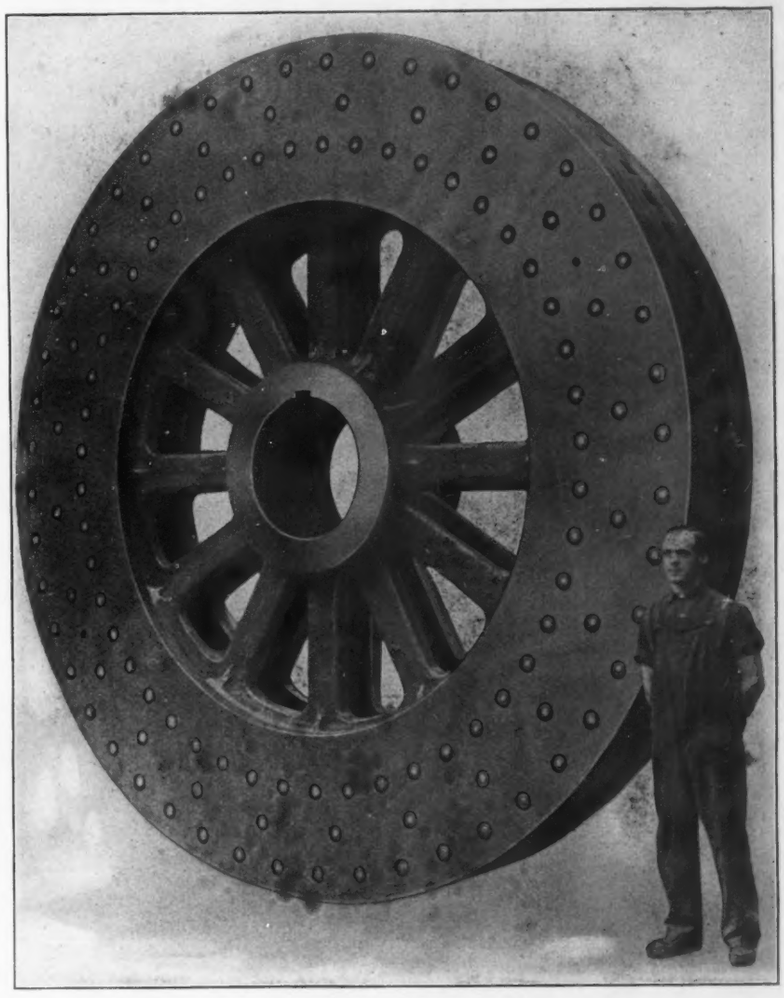


FIG. 9—LAMINATED STEEL FLY WHEEL FOR MILL MOTOR SET.

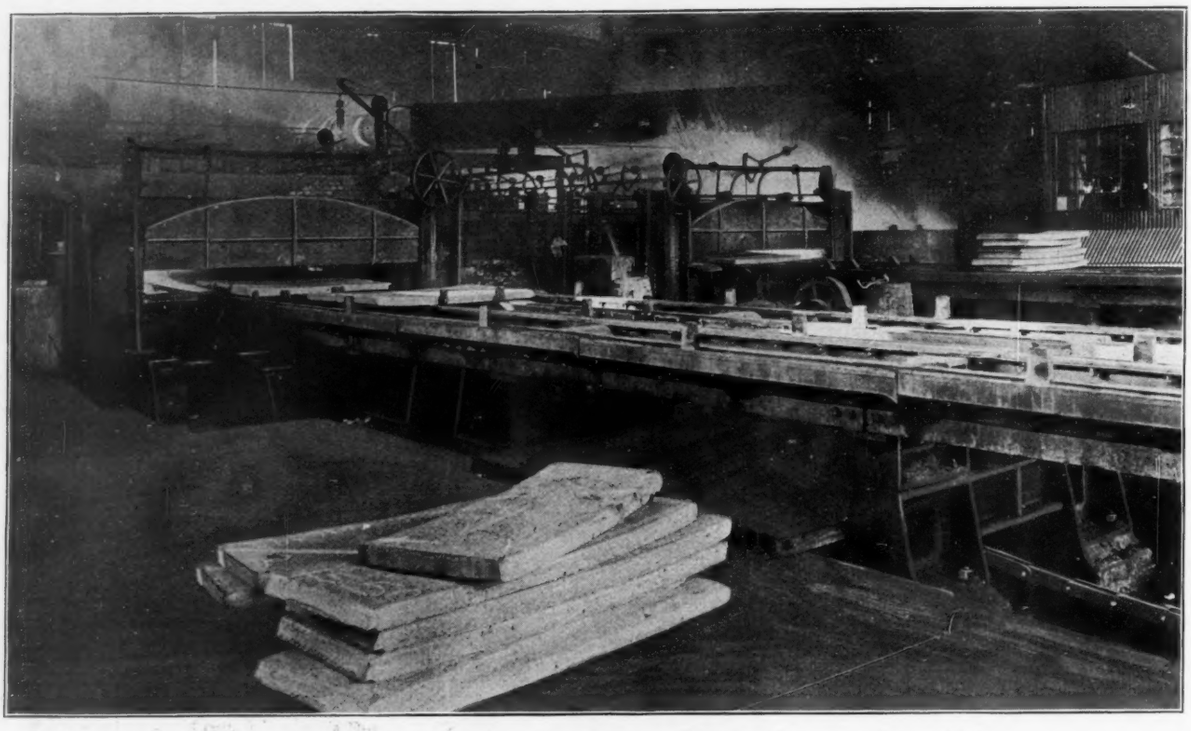


FIG. 10—CHARGING END OF HEATING FURNACES FOR 30-INCH UNIVERSAL PLATE MILL.

ply this power to the mills, the electric drive is the best medium from the standpoint, both of expense and results that has been devised.

The heating plant for the mill consists of two continuous furnaces, each 40 feet long and 11 feet wide, shown at the charging and delivery ends respectively in Figs. 10 and 11. The furnaces were designed especially by the Illinois Steel Co., engineers, but do not represent any radical departures from similar furnaces. They are capable of handling slabs 10 feet long and 10 inches thick which are delivered at the rear of the furnace on trucks from the slabbing mill to a slab storage yard, 80 x 300 feet. Here they are picked up by a 15-ton Whiting crane and placed on a transfer feeding table 40 feet long, which carries them into the furnace where they are fed through by

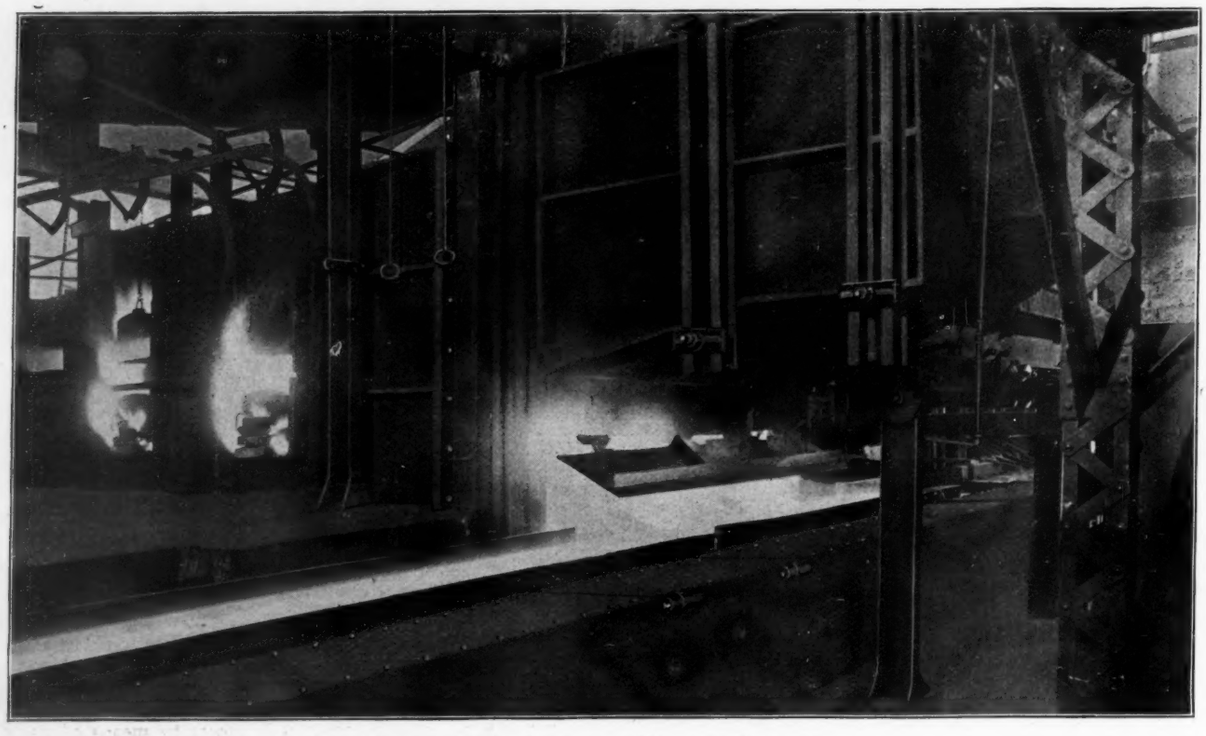


FIG. 11—DELIVERY END OF HEATING FURNACES.

the continuous movement of the table and dropped out of the other end of the furnace by gravity directly on to the approach table of the plate mill. The furnaces are located at the south end of the plate mill building, where the slabs can be conveniently delivered from the slabbing mill and are set at right angles to the mill. Each furnace has a capacity for heating from 175 to 200 tons of slabs every 12 hours, so that the heating capacity is slightly greater than the rolling capacity of the mill, which is equipped to roll about 300 tons per turn. The furnaces are heated with the regenerative heating system, the gas for combustion coming from a gas producer plant nearby the mill building, and shown in Fig. 2. The gas valves for the heating system, the furnace doors and the slab pusher are hydraulically operated, which is the only departure in the entire mill from electric motor drive. The transfer tables for conveying the slabs to the furnace are driven by 50-horsepower motors. The approach table for the mill is about 60 feet long, affording quick delivery of the heated slab from the furnace to the rolls.

The mill itself is of unique design worked out by the engineers of the Illinois Steel Co. in co-operation with the United Engineering & Foundry Co., Pittsburg, which built the entire plant. It has been made very rigid and compact, with the vertical rolls set much closer to the horizontal rolls than has been the practice heretofore, and it possesses other advantages from an operating point of view in the accessibility of parts. The vertical rolls can be removed by a straight lift without disturbing the driving shafts. The arrangement of the gears also greatly facilitates repairs The main rolls are 24 inches in diameter by 67 inches long, with 18-inch necks, and the side rolls are 15 inches in diameter with 8-inch necks, these latter being driven by means of bevel gears on the top and bottom of all shafts from the one set of main pinions. These main pinions are 26 inches pitch diameter with straight staggered teeth, and the gears driving the side rolls are in proportion to the rolling diameter. The main roll and side roll screws are driven by motors which are made sufficiently strong to release the coils from the plate under draft when necessary. The mill will roll universal plates from 6½ to 29½ inches wide up to 80 feet long, with a monthly capacity of 7,500 tons. The ordinary arrangement and methods for removing scales by means of water jets with a solution of salt are employed.

The hot beds, which are shown in Fig. 12, are in keeping with the design of the remainder of the mill and are entirely driven by electric motors of 30 and 50 horsepower. The hot beds are built in two sections, each 80 feet long and with 50 feet lateral traverse. Each section is operated by a separate drive, so that plates 80 feet long, or under, may be handled alternately on each section, providing thereby maximum capacity. It is also possible to handle plates more than 80 feet long by running them over on to both hot beds, though the necessity for obtaining an exactly simultaneous operation of the two separate drives makes this undesirable. The delivery roll table from the mill extends parallel to the hot beds, as shown in Fig. 12, through their entire length. The hot bed is built of rail sections for supporting the plates interspersed with conveying chains for transfering the plates across the hot beds. These chains run between the rolls through the mill table on which the plate is delivered, and by means of a lifting mechanism they can be raised up, elevating the plates from the rolls and carrying them over to a table between the roll tables and the hot bed on which the plates are placed against a row of lugs On the opposite side of this table from the lugs are placed a set of movable dogs operated by motor-driven screws, the brackets for which are shown in Fig. 12 before the screws were set in place. These dogs are moved up against the plate deposited on the table in absolutely parallel alignment to the lugs, so that this table constitutes a side straightener removing from the plate all of its lateral distortion. Here the plate is allowed to cool sufficiently, so that it retains permanently this shape. The hot bed chains are again raised and carry the plate over on to the hot bed, where it is moved

FIG. 12—HOT BEDS FOR 30-INCH UNIVERSAL PLATE MILL—LOOKING TOWARD MILL.

across as rapidly as desired. At the opposite side each plate is inspected, labeled with a heat number and marked with necessary specifications. From the hot bed the plates are shifted on a conveying table which carries the plate to straightening rolls where all the surface bends are removed. There are two straighteners installed of sizes adapted to the range of plates rolled, which not only increased the capacity but reduced the time and labor of straightening. From the straightener the plates are conveyed on another table to a shear, where they are cut in length to the specifications marked upon them. The finishing end of the mill is equipped with two 10-ton Whiting cranes and the shipping and storage dock is built of concrete and has ample floor space to more than accommodate the capacity of the mill. It is on a level with the mill floor, which is built for various reasons at such a height above the ground level that the loading tracks running into the mill building parallel with the shipping dock, set the cars, with their tops level with the floor of the dock car, facilitating in a great measure the easy loading of the plates. The length of the dock is sufficiently great, so that there is room on the two parallel standard gage tracks for 14 cars.

The mill is located on the west side of the South works plant and as the first universal mill of the Chicago district fills a long felt need.

WORLD'S ORE OUTPUT.

Consul-General Robert J. Wynne, of London, reports that the preliminary figures so far available to the British Board of Trade are contained in a return issued the latter part of November. It is estimated that the world's output of iron ore in 1906 was about 125,000,000 tons, the principal producers being the United States, Germany, the United Kingdom, and Spain, in the order given, these countries accounting for about 78 per cent of the total output. The figures show that in the United States there was an output of 7,000,000 tons more than in 1905, the total being rather under 50,000,000 tons. In Germany there was an increase of over 3,000,000 tons, and in the United Kingdom and Spain of 1,000,000 tons each.

There was a further large increase in the production of steel in the United States, while the production of Germany increasd by about 1,000,000 tons, and that of the United Kingdom by about 650,000 tons.

A MODERN BILLET MILL ENGINE EQUIPMENT

In January of 1907 the Carnegie Steel Co. put into operation a new 14-inch continuous bar and billet mill at the Duquesne steel works, which has been very successful from the first. The mill is direct driven by a 42 and 74 x 60-inch tandem-compound condensing Corliss engine, built by the C. & G. Cooper Co., Mt. Vernon, O.

Figs. 1 and 2 show this engine in the course of erection in the Cooper company's shops. The new mill and engine were installed without shutting down the other mills operating in the same building. After the new engine had run slowly a few hours the load was put on the mill, and since that time this equipment has made an unusual record for continuous running and heavy tonnage. The engine will be recognized as one of the Cooper company's latest patterns for rolling mill duty, and is similar in all essential details to several large mill engines recently furnished to the

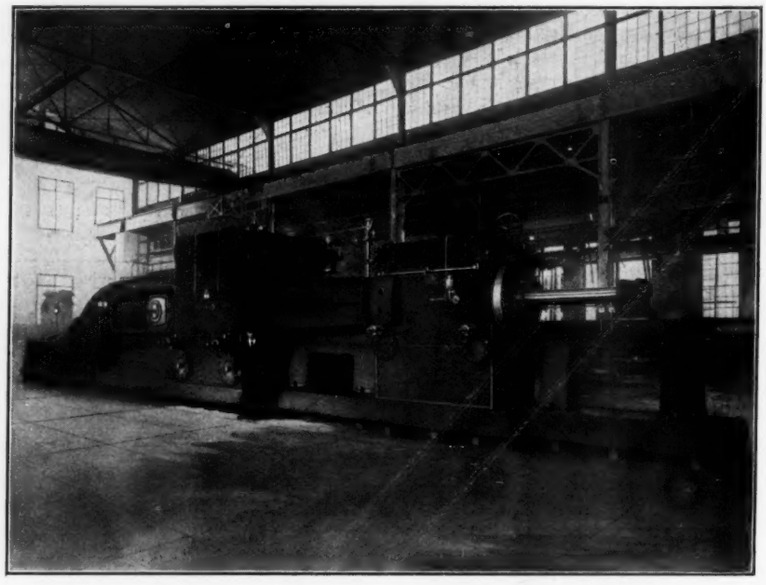


FIG. 1—ENGINE IN COURSE OF ERECTION—CRANK SIDE.

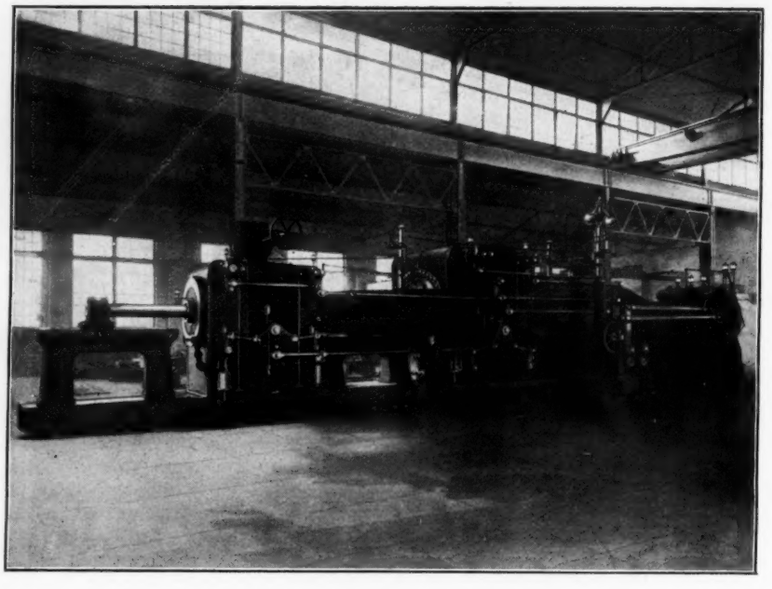


FIG. 2—ENGINE IN COURSE OF ERECTION—VALVE GEAR SIDE.

Carnegie Steel Co., the Jones & Laughlin Steel Co., and other leading steel mills in this country.

The valve gear throughout is of steel and phosphor-bronze bushed in all the bearings. The steam valve cranks of both cylinders are direct and independently driven from the eccentric rocker arms, avoiding the use of wrist plates. Fig. 3 is a detail photograph of this gear. All of the valves are double ported, and the inlet valves of each cylinder are under the control of the governor to 75 per cent of the stroke. The eccentric and reach rods are open-hearth steel forgings, having solid ends fitted with phosphor-bronze pin boxes, which are adjustable to take up wear. The reach rods to the valve gear are fitted with an ingenious disconnecting device whereby the valves may be worked by hand, or the engine reversed under control of the backing arrangement to be seen on the high pressure cylinder in Fig. 3. The overhang of the valve gear is unusually short. The steam valve arms in each case are within the bonnets, having ample bearing surfaces on either side. The dash pots are close to the body of the cylinders, and are of the piston oil sealed type, having no packing in them subject to wear. As is made clear in the illustrations the pistons are of the floating type, being supported on forged steel hollow rods between the main, intermediate and supplementary crossheads, all of which have adjustable babbited slippers. These pistons are steel castings of the umbrella type, and are provided with followers and self-acting steam packing rings. All wearing joints such as crank and crosshead pins, piston rods, valves and main journals are carefully ground and highly polished, securing a thoroughly smooth working fit from the start. The general design of this engine is such that it practically eliminates the usual objections to the tandem type of engine, in that the form and location of distance pieces between the cylinders maintain easy accessibility to both cylinders, and the deep sub-base extending underneath the engine insures accurate alignment more or less independently of the foundations. The main bed plate is of massive box construction, having extra depth underneath the main journal to give increased strength at this point, and also to interlock with the foundation to resist lateral strains. The outboard pillow block is of the pedestal type, as illustrated in Fig. 4, and weighs about 52,000 pounds. A beaded edge or oil channel is cast around the main engine base plate, as well as the outboard pillow block, to catch any oil drips so that they may be returned to the gravity oiling system. The main shaft is 27 inches diameter in the wheel fit, 25 inches diameter in the bearings, and is a hollow bored steel forging. The crank is a double-web steel casting of the counterbalanced disc type. The fly wheel of the engine is 22-feet diameter, and of segmental construction, as shown in Fig. 5. The governor is of the special weighted inertia type, driven by three 1-inch manilla ropes, and is so arranged that in case of serious accident to this drive, the inlet valves are not permitted to open. Practically uniform speed is maintained by this governor under all conditions of load.

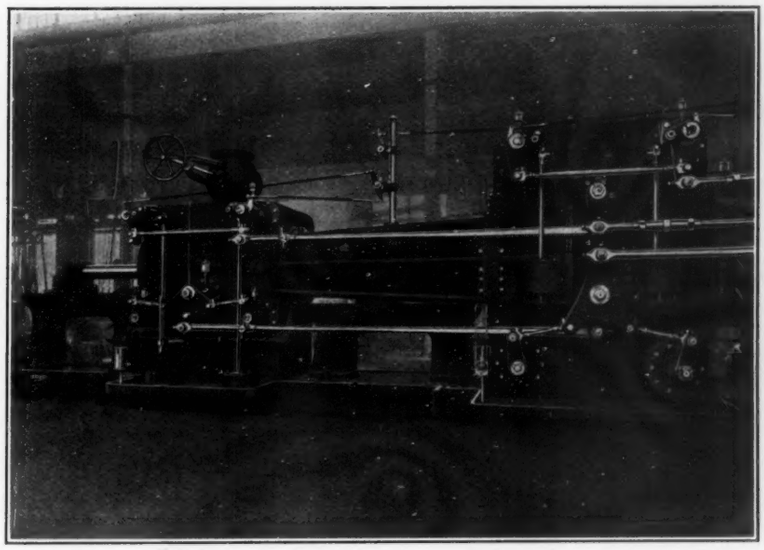


FIG. 3—VALVE GEARING OF ENGINE.

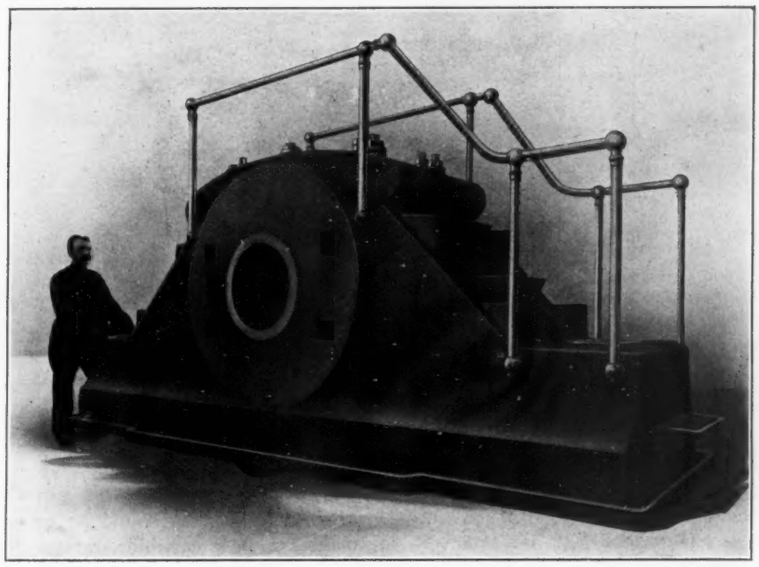


FIG. 4—OUTBOARD PILLOW BLOCK.

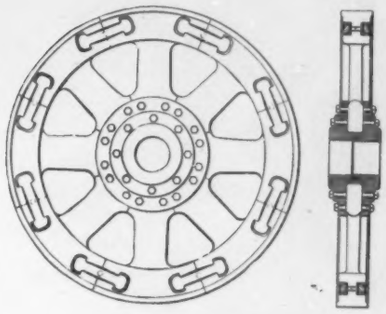


FIG. 5—ELEVATION AND SECTION OF FLY WHEEL.

SOME NOTEWORTHY FEATURES OF THE SHEPARD ELECTRIC HOIST.

In the construction of the electric hoist the past few years have witnessed an important advance. The improvements installed have been chiefly concerned with the perfecting of the finer points of this type of mechanism and are of interest as showing the incessant striving in the manufacturing field for what is absolutely best and most efficient in the way of equipment. In the crane and hoist line the success of this endeavor is evidenced by the remarkable increase of late in the number of installations.

The Shepard electric hoist, manufactured by the General Pneumatic Tool Co., Montour Falls, N. Y., has kept pace with the advance and the leading features emphasized in its design illustrate the thoroughness of present-day hoist construction. These features include a rugged type of hoist, yet without sacrifice of a hoist essential, compactness; they include, also, complete accessibility, the elimination of delicate adjustments, a lubricating system that can be relied upon at all times, and the provision of elastic speed control arrangements. In addition, a thorough interchangeability of hoist parts with corresponding parts of the traveling cranes turned out by this company has been secured.

A hoist design that is at once compact and rugged, yet at the same time affording complete accessibility to any part, is of necessity something of a development, since no improvement involving any of these requirements could be introduced unless it made accessible every important group of parts without disturbing any related parts. For instance, in the present model, if it becomes necessary to remove the motor armature, no part of the electric wiring need be disturbed except the armature leads. No part of the hoist mechanism need be removed except the front housing of the motor. This same method is observed with all other parts and the hoist is so constructed that only a wrench and screwdriver are needed to take it apart or reassemble it, no special tools being required.

Along with the working out of a hoist design that combines both the essentials of compactness and accessibility, an unusually heavy type of construction has been developed. The electric hoist is commonly installed for the handling of light and medium loads and is intended for operation by unskilled workmen; hence it must be made safe for large overloads and capable of sustaining without injury treatment that is really abusive. To meet these requirements all parts are made of unusual strength and all wearing surfaces are of much greater extent than would be considered necessary in a machine certain to receive careful treatment at the hands of skilled operatives. This has been possible without exceeding dimensions and weight conceded for hoists of equal rated capacity.

Closely related requirements which have also been met are the working out of the adjustment problem and the securing of a dependable lubrication system. Presuming that adjustable parts imply the necessity of delicate adjustment and the exercise of considerable skill, the Shepard hoists have been designed with no adjustable parts whatever. All parts are

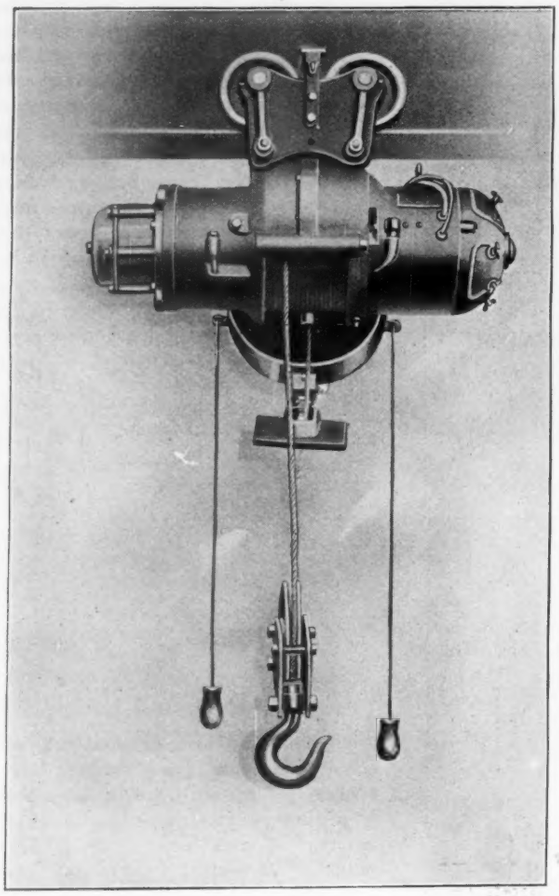


FIG. 1—SHEPARD SINGLE I-BEAM ELECTRIC HOIST.

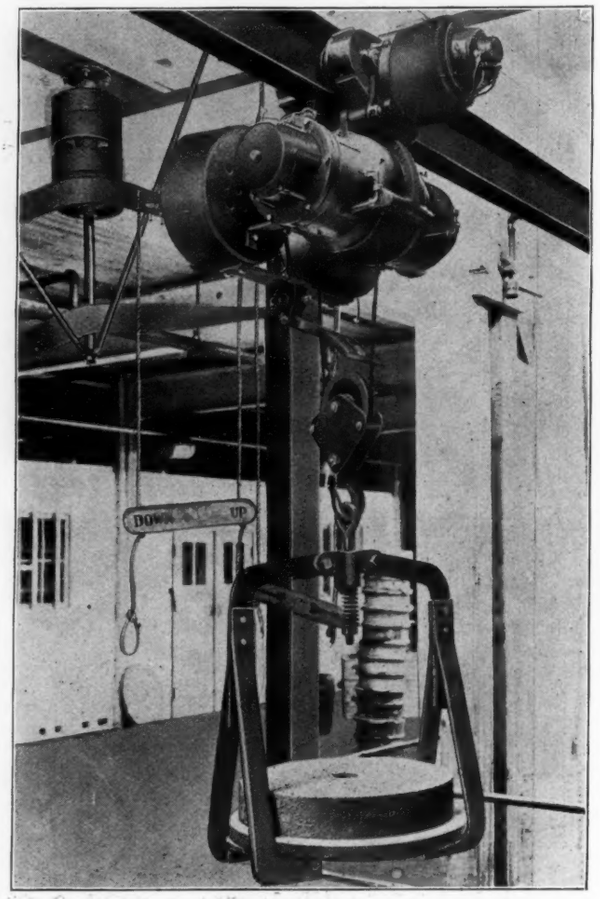


FIG. 2—SHEPARD 2-MOTOR TRAVELING ELECTRIC HOIST AT WORKS OF THE NORTON CO., WORCESTER, MASS.

made to take permanently their proper position and are designed with sufficient margin of safety to continue perfect operation notwithstanding any disturbance due to natural wear. This feature is of importance in the removal or replacement of parts. The scant attention frequently given by the operator to the lubrication of the hoist demands that the design be such as will insure thorough and constant lubrication of all running parts. In this hoist, the filling of three conspicuous oil reservoirs will make certain the proper oiling of every part and, even if not refilled for a long period, will protect the machine from harm.

The matter of speed control in the electric hoist is one of importance. It has been a common error to suppose that no advantage is found in the use of a hoist having ample speed control for operations not requiring delicate handling of the load. While it is true that no very evident harm can result from turning the full voltage into series wound motors of small size, there is every reason for believing that any long continuance of this process will result in serious damage to the motor and injurious shock upon shafts, gears and hoisting rope, and that the opening of the circuit under full voltage and current strength causes serious damage to the controller contacts.

In the Shepard hoists controllers affording an unusual number of resistance steps are provided, and the value of this feature in protecting both the motor and controller has been so evident that the number of steps will shortly be increased to 14 for hoists of the smallest size and to 18 in the largest size. This will not only afford the most delicate control of the hoisting and lowering speeds, when needed, but will guarantee for all service a gradual increment of current strength in starting the motor and a correspondingly gradual and ample decrease before the circuit is opened to stop the motor. This improvement will also have the effect of lessening the care necessary to maintain the electrical features of the hoist in good condition.

The interchangeability of parts has been developed to a high degree in the design of the Shepard hoisting apparatus. It has been found possible to employ in the electric hoists parts identical in material and construction with those used in traveling cranes of the same capacity, with resultant economy in manufacture, on the one hand, and the convenience of carrying but one set of repair parts for two or more machines of like capacity, on the other. This hoist is also unique in the facility with which it can be applied to winding operations of practically every variety without material change of any part, except to adapt the frame to the structure to which it will be attached. This feature is well brought out by a comparison of the single I-beam electric hoist, shown in Fig. 1, with the pneumatic motor hoist of the hook type, shown in Fig. 4. In the case of this last machine the gearing, load brakes, drum and trolley are identical with those of the electric hoist of equal capacity.

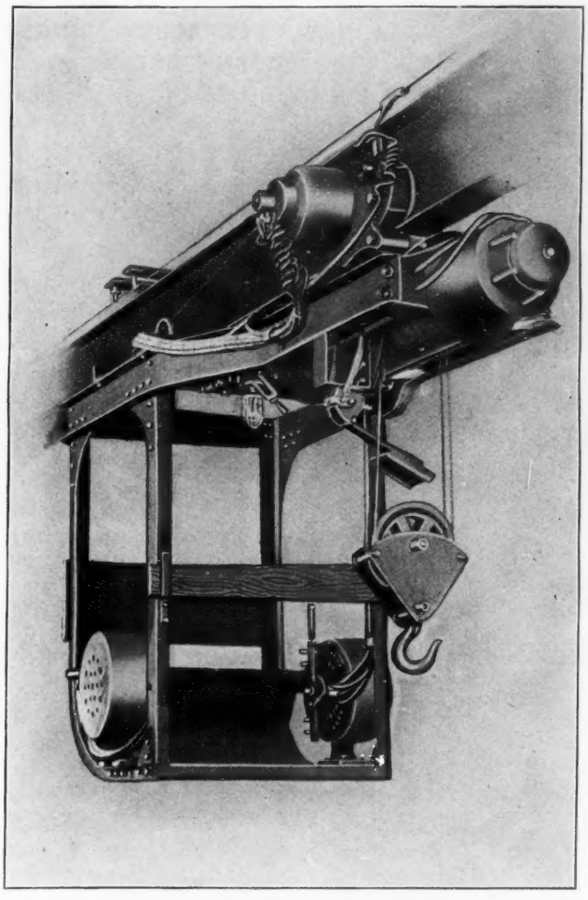


FIG. 3—SHEPARD CAGE-CONTROLLED, 2-MOTOR TRAVELING ELECTRIC HOIST AT NEW PLANT OF AMERICAN-LA FRANCE FIRE ENGINE CO., ELMIRA, N. Y.

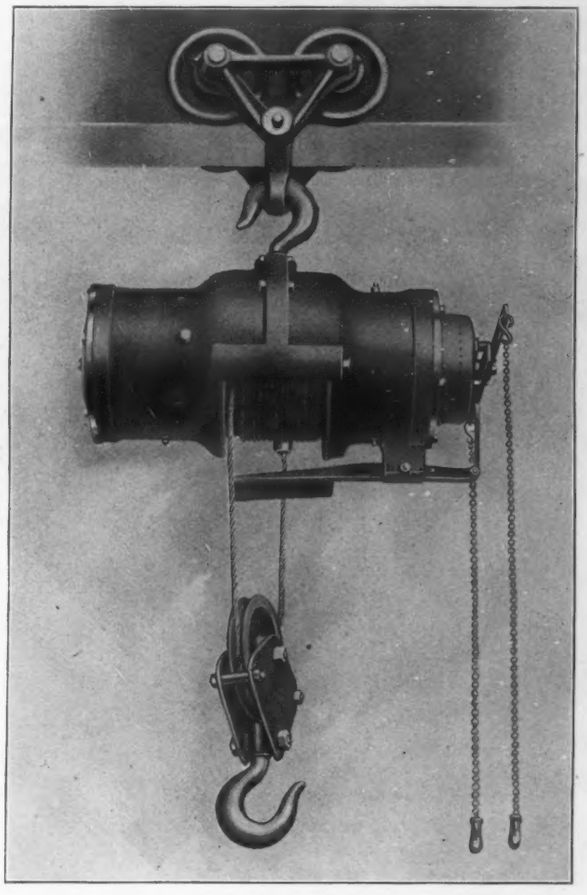
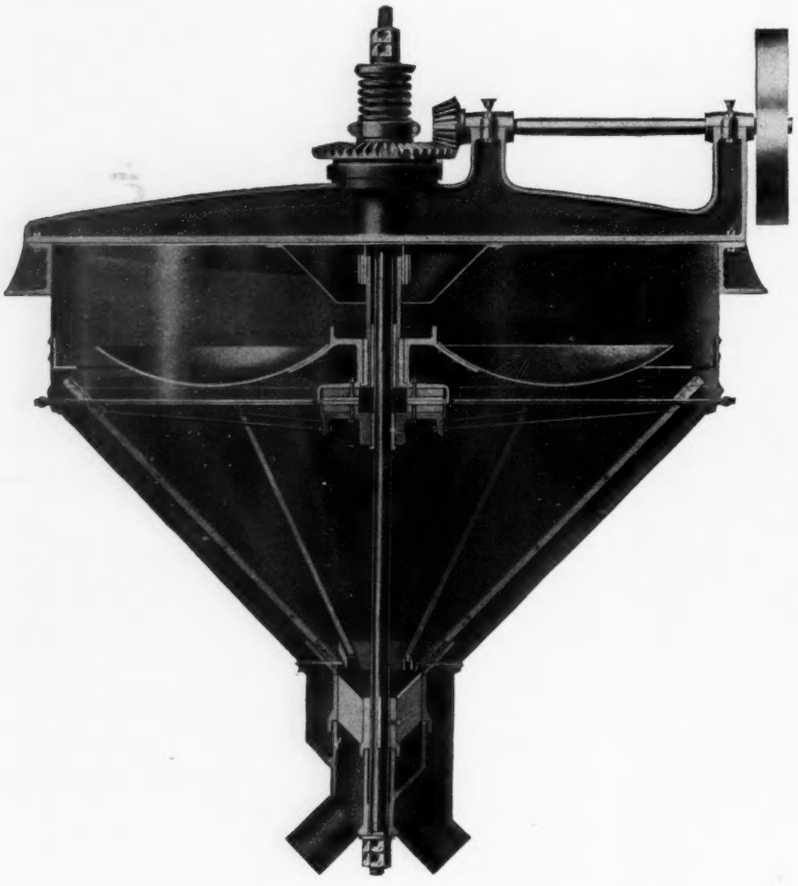


FIG. 4—SHEPARD PNEUMATIC MOTOR HOIST OF THE HOOK TYPE.

A NEW VIBRATOR SEPARATOR.

The illustration below shows the "Vibracone" separator, built by the Stephens-Adamson Co., Aurora, Ill., as a general separating device. This separator consists essentially of a seamless steel disc distributor, a cone shaped screen and ratchet vibrator mechanism. The distributor consists of a seamless pressed steel disc 3/16 inch thick and six feet in diameter, dished as shown in the illustrations. It operates at the rate of 33 1/3 revolutions per minute, giving it a peripheral speed of approximately 625 feet per minute. The screening surface is built up of eight sections of steel or brass wire set at an angle of 45 degrees, and of such size and mesh as is best adapted to the service for which the separator is intended. These sections are fastened to steel sash bars by means of eccentric clips, which facilitate their easy removal and replacement. The distributor feeds material to the screen with such uniformity that uneven wear of the screen is avoided. A removable door is located in the outside steel shell, through which the screen sections can be removed, and provision is made for revolving the entire screen while the machine is at rest, so that each screen in turn can be removed readily through this door. The vibrating mechanism, located just below the distributor, consists of a pair of chilled tooth ratchet plates. One of these plates is rigidly attached to the steel quill which also drives the distributor, the other being attached to a stationary screen frame. As the distributor revolves, the material is dropped on the screen the vibration of which is at the rate of 600 impacts per minute, which are absolutely uniform and at the same time without violence. This vibrating motion can be adjusted within a wide range to increase or decrease the degree of vibration.



THE "VIBRACONE" SEPARATOR.

The entire driving mechanism, which operates the distributor and vibrator, is carried on a ball bearing. The driving quill is made of steel babbited with high grade metal and well lubricated. The outside shell or casing for the separator is of 3/16-inch steel with but one opening, the door for removing the screen sections. The top cover plate also has but one opening, that for the feed hopper and it is made of No. 10 steel plate. Every effort has been made to make the joints tight and provide a dustless machine. The total height of the vibracone is 8 feet 9 inches, the width 8 feet 3 inches and the weight about 3,000 pounds. About one-half horsepower is required for driving. The vibracone is intended to screen either wet or dry material through screens from ½ inch to 200 meshes per inch, and is particularly adapted to cement mill screening. The driving shaft is intended to run 100 revolutions per minute, and has a standard pulley 24 inches in diameter and 4 inches face.

A NEW FERRACUTE SINGLE-CRANK PRESS.

The accompanying illustration shows a massive single-crank press just built by the Ferracute Machine Co., Bridgeton, N. J., from new patterns after designs of Oberlin Smith, the president and mechanical engineer of the company.

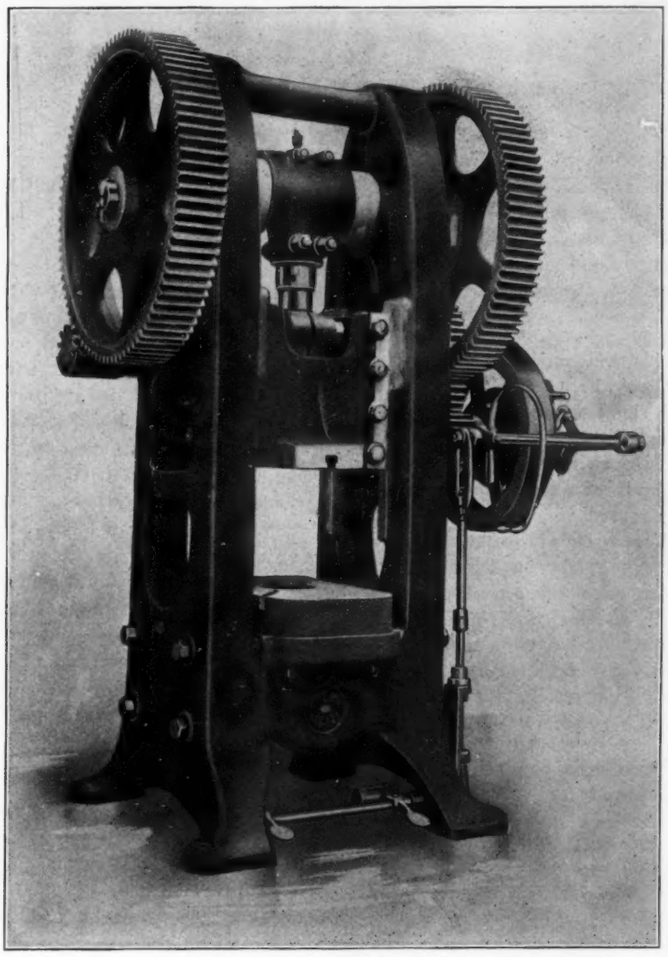
In common with other machines of this nature the press has a long stroke which adapts it for drawing cold from heavy sheet steel, deep drawn seamless shells, automobile hubs, cups for ball-bearings and similar work. It can be built with shorter stroke for heavy blanking, trimming, shearing and embossing. A somewhat larger press of this series recently built by the Ferracute Machine Co. for the United States government is being used in the manufacture of cartridge shells for cannon.

The machine we illustrate is known by the makers as press DGG121. The castings which compose the frame are exceedingly heavy and show evidence of careful work in the pattern shop, their neatly rounded corners adding considerably to the appearance of the press. Other striking features are the heavily trussed bed and the wide-faced twin gears on each side of the press. These gears are cut from the solid. Having two gears on the crank shaft instead of one tends to relieve the torsional stress of the shaft and affords an even pressure, besides dividing the load between them. The back shaft, with its two pinions which engage the large gears, is a single steel forging made enormously strong to obviate any torsional effect. It provides an equal and even pressure from pinions to twin gears and prevents uneven strains to the frame and moving parts connected thereto.

The main shaft is forged from high carbon steel. The pitman-stem is six inches diameter and is also made of steel. The clutch and fly wheel are mounted on a stud which is rigidly attached to the frame, thereby pre-

venting any disturbance of alignment which is apt to occur when such supports are detached and bolted to the floor.

The press is equipped with a "multi-disk" friction clutch of a new and effective design. It is of the automatic stop type but can be quickly adjusted for stopping the ram by hand at any point of its descent or ascent, or, if desired, can be set for continuous running. Positive knockouts (not shown) are provided when desired, the press being designed so that they can be readily attached.



NEW FERRACUTE SINGLE CRANK PRESS.

The distance between columns is 28 inches; the stroke is 3 inches, but it can be made, if desired, any length up to 17 inches; height, bed to ram when up, 19½ inches; adjustment of ram, 6 inches; flywheel, 35 inches diameter and 6 inches face, weighing 750 pounds. The press occupies a floor space of 8 feet 7 inches from right to left and 5 feet 5 inches front to back, and is 10 feet 7 inches high. It weighs 25,000 pounds, and exerts a pressure of 200 tons.

A NEW RECORDING MILLI-VOLT METER AND SHUNT AMMETER.

We present herewith illustrations of an accurate and sensitive recording milli-volt meter which is adapted to practical everyday service as well as for laboratory tests, together with a recording ammeter of the shunt type which can be connected by leads to the main bus-bar. The shunt system is especially economical where heavy currents are to be indicated or recorded, as the instruments may be located at a considerable distance from the main current, thus saving great expense in carrying the main conductors to the point where the instrument is located.

The two most important fundamental features of these recorders, are a sensitive electrical movement of special design made by the Weston Electrical Instrument Co., and a new recording system using a smoked chart patented by William H. Bristol and described in previous issues of the THE IRON TRADE REVIEW. The chart is arranged so that there is no friction between the recording arm and the chart.

These instruments are so sensitive that the recording arm will move over the whole scale for five milli-volts or less, making it possible to accurately record 0.0001 volt. The graduations on the chart are evenly proportioned over the entire range, the same as the Weston ammeter, so that even though there is only a small current flowing, the readings may be as readily taken as if the current was the maximum that the instrument would record. This feature will be greatly appreciated, as there are many places where it is desired to install instruments for increasing future demands and it is important that the records be perfectly clear, even though the loads are very light when the outfit is first installed.

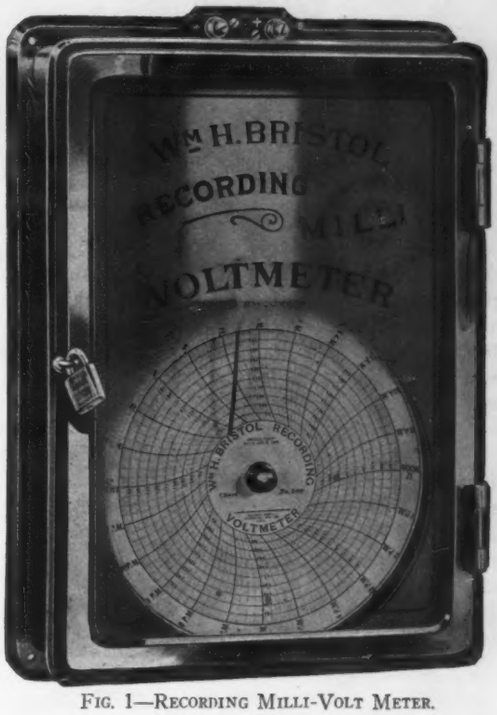


FIG. 1—RECORDING MILLI-VOLT METER.

The records are made on the semi-transparent smoked chart, which is periodically brought into momentary contact with the end of the recording arm. In this way a series of white dots is made on the smoked surface forming a continuous line and a record is thus made without causing any friction between the moving arm and the chart. The rate of vibration of the chart is timed to suit the frequency and range of the variation in the current to be recorded. The usual period of vibration of the chart is once in ten seconds, but to obtain continuous lines where the fluctuations of the current are quite rapid, the vibrating attachment is made to operate twice every second.

The recording milli-volt meter is shown in Fig. 1, and Fig. 2 is a reduced fac-simile of a chart taken from one of these instruments in connection with electrolysis surveys of underground structures which are being conducted by the Electrical Testing Laboratories of New York City. The graduations of this chart are arbitrary. It was revolved once in 24 hours and was vibrated once every ten seconds.

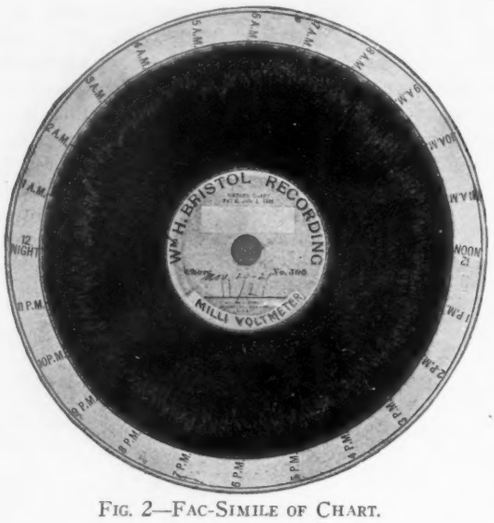


FIG. 2—FAC-SIMILE OF CHART.

It is expected that by using a number of these instruments operating simultaneously at different points, stray currents in water and gas mains or in any underground structure may be recorded, making it possible to discover the causes of trouble and how they may be eliminated.

The recording ammeter is shown in Fig. 3 connected to a standard Weston 10,000-ampere shunt, to which is also connected a Weston indicating station ammeter. This illustration shows that the recorder may be readily applied to any standard shunt which is already in service, without disturbing the indicating instrument at the switchboard. As illustrated here, leads of almost any desired length may be used to connect the indicating and recording instruments to the shunt on the main bus-bar. It is even possible to have the recording ammeter located in the superintendent's office at a great distance from the shunt and the indicating instrument located on the switchboard convenient for the observation of the operator. Such combination oufits could be furnished as units, with leads of the proper lengths to suit the individual cases.

These instruments are manufactured by Wm. H. Bristol, 45 Vesey street, New York.

SHOWING FAVORABLE TO STEAM TURBINE.

Writing with regard to statements made by him in the article published on page 57 of the Jan. 2 issue of THE IRON TRADE REVIEW, W. T. Dean says:—

"A more conservative and probably more nearly average assumption of a fuel economy from gas fires under boilers, would be 23,000 B. T. U. per kilowatt instead of 21,000 B. T. U. per kilowatt as stated.

"Referring also to the statement that a steam turbine plant can be built for $60.00 per kilowatt and that a gas engine plant can be built for $100.00 per kilowatt, it is to be remembered that the figure for the gas engine plant is undoubtedly low when all the elements are considered and that a turbine plant can be built for $45.00 per kilowatt where no coal storage plant is required and further that a turbine plant can be built for $40.00 per kilowatt where cheap real estate is available. My assumed figure of $60.00 per kilowatt was based on a complete coal burning plant with coal and ash handling machinery and included real estate in a great city where land values form a considerable portion of the total investment. These modifications make very material difference in the

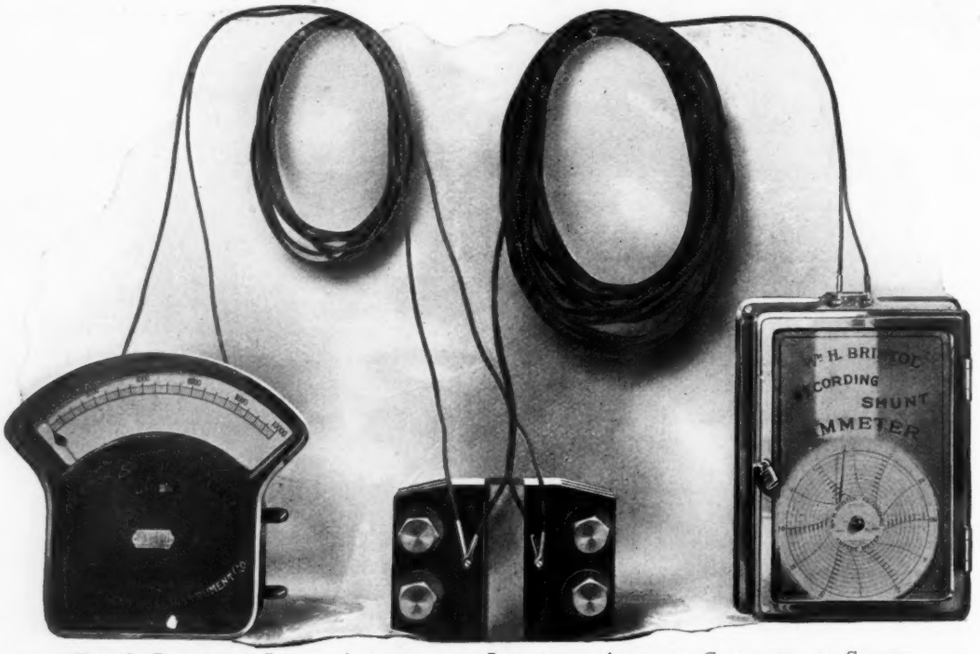


FIG. 3—RECORDING SHUNT AMMETER AND INDICATING AMMETER CONNECTED TO SHUNT.

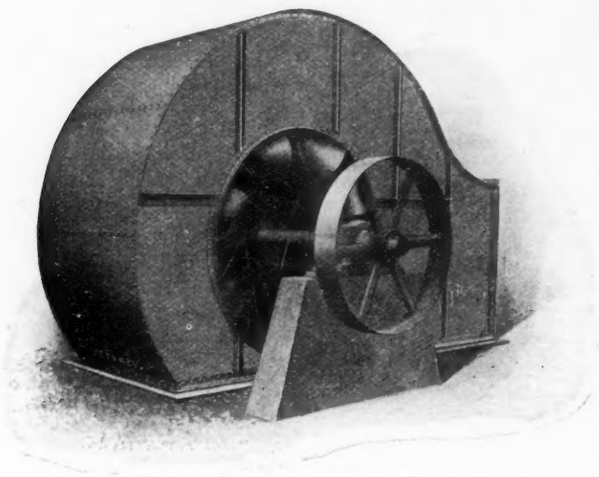


FIG. 1—NEW JEFFREY MINE FAN.

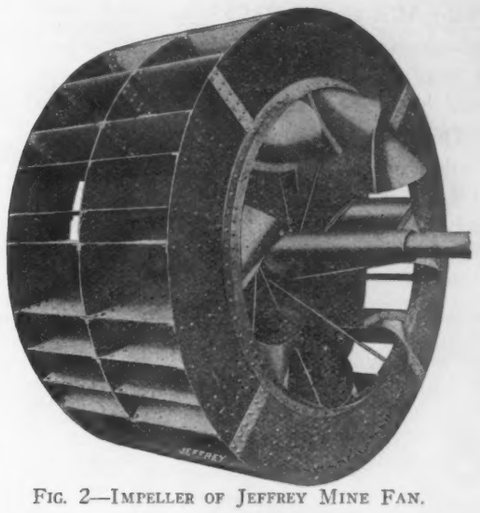


FIG. 2—IMPELLER OF JEFFREY MINE FAN.

total investment in a large plant and on this point the showing in favor of a turbine plant is much greater than indicated in my article."

1906 COPPER PRODUCTION. FIGURES REVISED.

A review of the copper statistics of the United States for the year 1906 has been announced by the United States Geological Survey and the estimate of the production of refined copper in the United States in 1906 is given as 917,805,682 pounds, spelter production and not 906,591,947 pounds as earlier stated. An increase in the production of Montana caused the revised total. The government at the same time raises its estimate on the amount of copper consumed from 680,000,000 pounds in 1906 to 685,000,000 pounds. Of this amount approximately 50 per cent went into the electrical industry.

The copper consumption in pounds was divided as follows:

Electrical industry	340,000,000
Brass manufacture	210,000,000
Copper sheets, etc.	35,000,000
Castings, etc.	100,000,000
Total consumption	685,000,000

The mine production of the United States for the year 1906 is estimated by the Geological Survey for the first time, and this totaled 916,971,387 pounds. In the year 1905 statistics for all districts were not available, so no comparison is forthcoming. However, the mine production last year exceeded that of the preceding year by a somewhat larger amount than the gain in smelter production, which indicates that last year the smelters were unable to keep up their production with the output from the mines.

A HIGH EFFICIENCY MINE FAN.

In view of the many recent mine explosions, due to insufficient ventilation special interest attaches to the announcement of a new centrifugal mine fan made by the Jeffrey Mfg. Co., of Columbus, O., for which it claims remarkably high efficiency, as indicated by the accompanying table. These results are obtained from a fan 10 feet diameter by 5 feet wide, two illustrations of which are shown, and which has been installed for purposes of demonstration at the company's works in Columbus.

Fan Discharging Into Free Air					Outlet Closed	
Rev. Per Minute.	Inches of Water.	Area of Discharge.	Velocity of Air Ft. Per Minute.	Volume Cu. Ft. Per Minute.	Per cent Volumetric Efficiency.	Inches of Water.	Per cent Manometric Efficiency.
50	0.15	34	1,530	52,020	265	0.22	67
100	0.6	34	3,070	104.380	266	0.9	66
150	1.4	34	4,700	159.800	271	2.0	70
200	2.5	34	6,280	213.520	272	3.6	71
250	3.8	34	7,750	263.500	268	5.3	72
300	5.6	34	9,390	319.260	271	8.0	70

The special features which give this fan large volumes at slow speeds and a large capacity against high gages are the concave, curved vanes which discharge the air in a true radial direction with no dragging effect on the wheel, and the conical scoops which are features of no other fan, and which, by their special forms and positions, prevent the gushing of air from the inlet.

The fan is made entirely of steel mounted on a hammered steel shaft with accurately machined cast iron hubs, and is held rigid and true by adjustable stay rods which offer no obstruction to the free inlet of air.

Another advantageous feature is the steel casing which extends to the ground line, eliminating the large amount of masonry usually required with fan installations.

The Ornamental Iron Work Co., Akron, O., expects to install some additional machinery in its plant within the next six months.

ITALY'S IRON AND STEEL TRADE IN 1906.

The iron and steel industry of Italy in 1906 showed substantial progress according to the following figures extracted from the "Revista del Servizio Minerario." In iron ore the output of the country in 1906 was 384,217 metric tons, of which the production of the island of Elba was 370,724 tons. In 1905 the total was 366,616 tons. Twenty-seven separate mines or workings were employed last year, as against 29 in 1905. The manganese ore output was 20,500 tons.

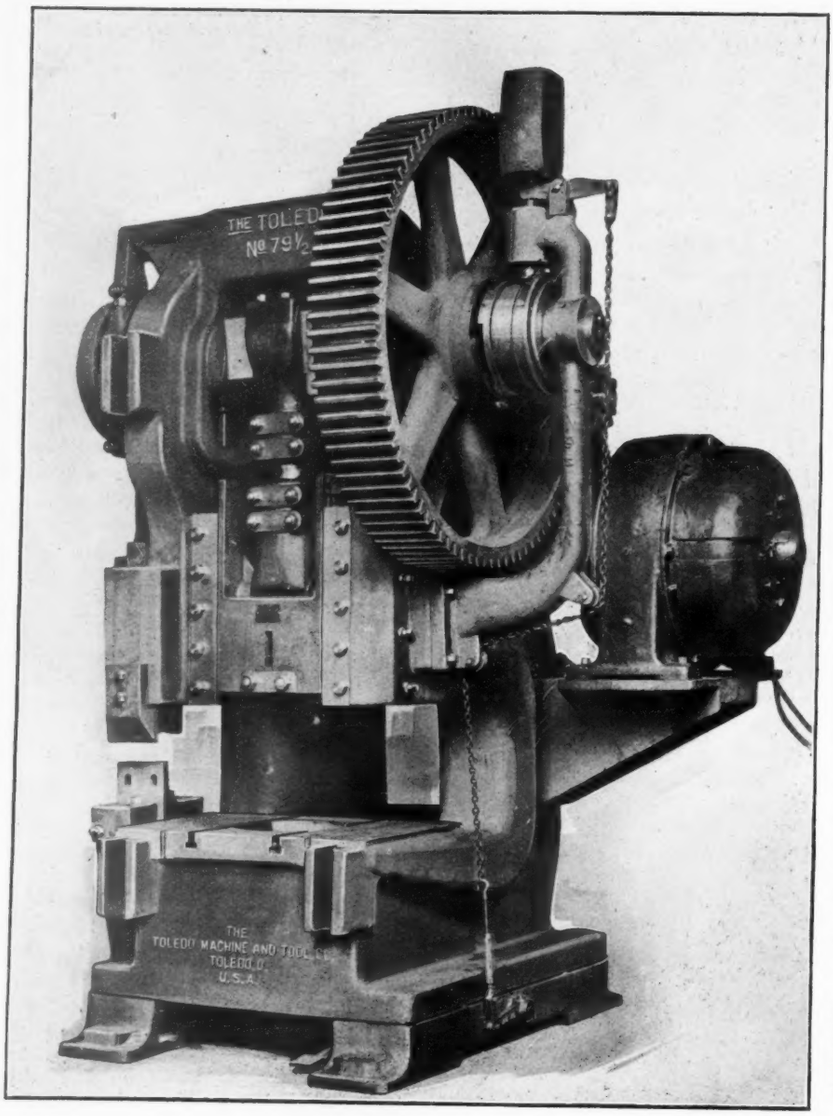
The production of pig iron in Italy during 1906 amounted to 135,296 metric tons, valued at 11,786,685 lire, or approximately $2,000,000, compared with 143,079 tons in the previous year. The active pig iron capacity of Italy consists of six furnaces and four plants, two being in the district of Firenze, with three active furnaces, and two in the Milan district, also with three furnaces. The latter, however, only produced 3,395 tons. There were 80 iron and steel works in operation in 1906, and these produced 45,644 metric tons of castings, 236,946 metric tons of finished iron and 332,924 metric tons of steel. In 1905 the totals were 76 works in operation with outputs of 38,169 metric tons of castings, 205,915 metric tons of finished iron and 244,793 metric tons of steel. The imports of pig iron in 1906 were 168,984 tons, against 136,077 tons in the previous year. Other iron and steel imported amounted to 251,293 metric tons,

AN OPEN-BACK PITMAN PRESS.

The accompanying illustration is of an unusually large open-back single pitman power press of the overhanging or gap pattern. This press was designed and built for use in one of the United States navy yards for trimming hot or cold forgings, and is fitted with a 20-horse-power motor, direct connected. The press is also intended for heavy blanking and shearing. The outer slide with which the machine is fitted has a shearing capacity for 3-inch square bars, hot.

The press is very powerfully geared and has an unusually long stroke or slide motion to the inner slide adapting it to the trimming of forgings of irregular or special shapes. Some of the measurements are as follows:

Clutch gear—	
Diameter	62 inches
Face	10 inches
Stroke or slide motion of—	
Outer side	3 inches
Inner side	7 inches
Balance wheel, diameter	50 inches
Weight	1,600 pounds
Distance between—	
Uprights or housing	27 inches
Bed to slide	20 inches
Bed areas—	
Right to left	41 inches
Front to back	28 inches
Distance back from slide center	16¼ inches
Net shipping weight of machine	35,000 pounds



TOLEDO SINGLE PITMAN PRESS.

This press is the largest of a series of 15 sizes designed and built by the Toledo Machine & Tool Co., of Toledo, O.

A company to manufacture boilers, sheet and plate iron products has been formed at Brazil, Ind., under the name of the John Vanes Boiler Works. John F. J. and Harry Vanes are the directors of the company, which has $10,000 capital.

PLAN ANNOUNCED

For the Ending of Receivership of Westinghouse Machine Co.

The plan for the lifting of the receivership of the Westinghouse Machine Co., Pittsburg, has been determined and approved by the board of directors of the company, by the receivers and by the principal creditors, the latter including only those of more than $1,000 claim each. The creditors of less than this figure are to be paid in cash. For the 75 creditors remaining to be considered, the plan has been endorsed by the committee representing holders of a large amount of the company's indebtedness and consisting of leading bankers and railroad officials of Pittsburg, Philadelphia, Boston and New York. It is contemplated in the course of action determined that the company shall issue three-year 6 per cent notes for its existing indebtedness. These notes are to be secured by the company's bonds at 85 per cent of their face value, as collateral, and are to be in denominations of $500 or multiples thereof. Claims of less than $1,000 are to be paid in cash. On claims exceeding $1,000 the creditor will receive three-year 6 per cent notes to the amount of the nearest multiple of $500 that is not in excess of the claim, the balance being paid in cash. It is further agreed that the company will not pay any dividends to its stockholders until provision has been made for the payment of all of the notes outstanding.

The balance sheet of the company's operations, as of Oct. 23, 1907, when the receivers took possession, which is being inclosed with the announcement of the plan to creditors, clearly shows the solvency of the company. The balance sheet is as follows:

ASSETS.

Property and plant		$ 6,156,256
Quick assets		467,160
Accounts receivable		2,312,330
Working assets		2,540,893
Investments		10,496,620
Other assets		1,837,326
Total		$23,343,425

LIABILITIES.

Capital stock		$ 7,373,450
Funded debt:		
First mortgage bonds	$ 245,000	
Debenture certificates	1,020,000	
		1,265,000
Current liabilities:		
Notes payable	$5,943,528	
Current accounts (including pay rolls, etc., amounting to about $225,000)	1,874,143	
		7,817,671
Reserves:		
For inventory depreciations and extraordinary adjustments		200,000
Profit and loss—Surplus		6,687,304
Total liabilities		$23,343,425

REVIEW OF THE AMERICAN IRON TRADE IN 1906 AND 1907[1]

By James M. Swank.

The year 1906 was another uniformly prosperous year for the American iron trade and for all the country's leading industries. The favorable financial and industrial conditions which had prevailed in 1905 and in other recent years were continued in 1906. It was a good year for the farmers. They harvested large crops and invariably received good prices for them. The mining and manufacturing industries of the country were actively employed. The railroads were taxed to their utmost capacity. There was a scarcity of labor in many industries. Wages were maintained at their previous high level and in many lines were further advanced. It is true that the San Francisco earthquake happened in April, 1906, and that in May, June and July the stock market was agitated by railroad legislation at Washington, but these occurrences did not seriously interrupt the country's industrial activity. All in all, 1906 was a year to be remembered as one of those years in our history when both labor and capital were fully and profitably employed.

In all leading branches of the iron trade production greatly increased in 1906 over 1905, which was itself a record year. The production of pig iron increased from 22,992,380 tons to 25,307,191 tons, and in all kinds of steel there were large increases, which are noted elsewhere. The total production of iron ore increased from 42,526,133 tons to 47,749,728 tons and the shipments of ore from the Lake Superior region increased from 34,353,-456 tons to 38,523,439 tons. Notwithstanding a decline of nearly 6,000,000 tons in the shipments of anthracite coal in 1906, due to over production in 1905, the country's total production of coal increased from 350,645,210 tons to 369,783,-284 tons. The above are all gross tons. The total production of coke increased from 32,231,129 net tons in 1905 to 36,-401,217 tons, and the shipments of Connellsville coke from 17,896,526 net tons to 19,999,326 tons. The tonnage of steel vessels built in 1906 increased from 248,-710 tons to 336,500 tons. There was a great increase in 1906 in the production of cars and locomotives. The Baldwin Locomotive Works built 2,250 locomotives in 1905 and 2,666 in 1906. They will probably build 2,720 in 1907.

Naturally, with an extraordinary production of iron and steel in 1906, the result solely of an extraordinary demand the prices of most finished and unfinished forms of these products were advanced during the year. The price of standard sections of steel rails remained stationary and uniform with that of immediately preceding years. Iron ore, coal and coke shared in the advance in prices in 1906. But none of the advances in prices in 1906 were sensational and all were made gradually.

As in 1905 there was an increase in 1906 in our imports of pig iron. In 1905 these imports rose to 212,466 tons and in 1906 they amounted to 379,828 tons. In each of these years a large part of the total imports represented spiegeleisen and ferro-manganese, as in former years, but foundry and Bessemer pig iron were also imported in considerable quantities to meet an urgent demand which could not be promptly met by the home producers. In 1905 our imports of these latter grades amounted to about 93,000 tons and in 1906 they amounted to about 180,000 tons. In the first nine months of 1907 our imports of all kinds of pig iron reached the total of 449,147 tons, fully one-half of which was of foundry and Bessemer qualities. The grand total of our imports of iron and steel in 1906 amounted in foreign value to $34,827,-132, against $26,401,283 in 1905. Our imports of iron ore in 1906 amounted to 1,060,390 tons, against 845,651 tons in 1905. In the first nine months of 1907 we imported 972,340 tons.

Our exports of iron and steel are rapidly increasing. In 1904 they amounted in value to $128,553,613 and in 1905 to $142,930,513, while in 1906 they reached the extraordinary total of $172,555,588. These figures will be exceeded in 1907, the exports in the first nine months amounting to $146,231,080. Included in the export statistics above given are all kinds of foundry products, tools and machinery, but it is noticeable that our exports of most forms of manufactured iron and steel, particularly steel rails, steel billets, sheets, plates, structural steel, wire nails, wire and other products chiefly of our rolling mills, have reached very large figures in the last few years, notwithstanding the active home demand for all iron and steel products. It was in 1904 that our export trade in steel rails and some other leading forms of finished iron and steel first assumed large proportions.

There were no serious strikes in the iron trade in 1906 and there have been none of consequence in 1907. In March, 1907, the rivers of Pennsylvania, West Virginia and the Ohio valley rose suddenly and overflowed their banks. Pittsburg and some neighboring localities suffered severely. The rise in the rivers began on March 12 and they continued to rise steadily for several days, the water at Pittsburg reaching its maximum height of 36.2 feet on Friday morning, March 15, at 5 o'clock, said to be the highest mark ever recorded. At many other places the rivers reached extraordinary if not unprecedented stages, and there was great damage to property, but the destruction at Pittsburg and its vicinity was unprecedented. The whole lower part of the city was under water. At the beginning of the flood 44 blast furnaces in Allegheny county were in blast, and of these 38 had to be banked for an average of two days. Work at most of the 65 or 70 rolling mills and steel works was also suspended.

The year 1907, which is drawing to its close as this report is written, has witnessed the sudden culmination of the period of remarkable and long continued prosperity which was ushered in early in 1899. The year began with bright prospects for the continuance of an active demand for all manufactured products, iron and steel included. Iron and steel prices had hardened in the closing months of 1906 and these advances were continued in the early part of 1907. The outlook was so favorable and the demand for iron and steel was so persistent that orders for pig iron and finished products to be delivered in the second and third quarters and even in the fourth quarter of the year were freely placed at current prices in the winter and spring months. This condition continued with little change but with some apprehension during the first half of the year, production in all lines being steadily maintained, the production of pig iron exceeding that of either of the half years of 1906. A panic in the stock market occurred in March, which gave rise to some of the apprehension mentioned, other causes being the attitude of the president toward the corporations, the large fine imposed by Judge Landis on the Standard Oil Co., and the certainty as the year progressed that some of the staple agricultural crops of the year would be short. Prices of pig iron had slightly yielded early in March and most grades continued to yield, the general impression being that they had been too high, compared with the prices of finished

[1]From the annual statistical report of the American Iron and Steel Association.

products. In July there was noticeable a slackening in the demand for iron and steel, and in August the stock market again weakened. Finally, at the beginning of the third week in October, there occurred a most serious break in stocks in Wall street, following damaging revelations in the management of some leading fiscal institutions in New York. At once the whole country became alarmed and the buoyant feeling which had accompanied a long period of prosperity, good prices, steady employment, and good wages was at an end. Some New York banks and trust companies closed their doors, and money was taken out of other banks in New York and other cities and hoarded. Credit and confidence were everywhere shaken. Whether these essentials of prosperity can be restored in the early future is the problem that now occupies the attention of all our business men. The outlook is more favorable today than it has been. But, while a partial recovery from unfavorable conditions is certain to come at an early day, a full recovery may be long delayed. Confidence will not be at once restored or credit be quickly re-established, although currency may be more easily obtained, nor will capitalists and men of affairs be as ready in the immediate future as they have been in recent years to set the wheels of industry in motion.

General Statistical Summary.

The accompanying table gives the shipments in 1905 and 1906 of Lake Superior iron ore, the shipments of coke and of anthracite coal, the total production of all kinds of iron and steel, iron ore, coal and coke, the imports and exports of iron and steel, etc.

General Statistical Summary.

Articles—Gross tons, except for coke and nails.	1905.	1906.
Shipments of iron ore from Lake Superior	34,353,456	38,523,439
Total production of iron ore	42,526,133	47,749,728
Shipments of Pennsylvania anthracite coal	61,410,201	55,698,595
Total production of all kinds of coal	350,645,210	369,783,284
Total production of coke, in net tons	32,231,129	36,401,217
Shipments of Connellsville coke, in net tons	17,896,526	19,999,326
Shipments of Pocahontas Flat Top coke, net tons	2,156,805	2,056,006
Production of pig iron, including spiegel. and ferro	22,992,380	25,307,191
Production of spiegel., ferro-mang., ferro-phos., etc.	293,976	305,642
Production of Bessemer steel ingots and castings	10,941,375	12,275,830
Production of open-hearth steel ingots and castings	8,971,376	10,980,413
Production of all kinds of steel ingots and castings	20,023,947	23,398,136
Production of structural shapes, not including plates	1,660,519	2,118,772
Production of plates and sheets, except nail plate	3,532,230	4,182,156
Production of iron and steel wire rods	1,808,688	1,871,614
Production of all rolled iron and steel, except rails	13,464,086	15,610,581
Production of Bessemer steel rails	3,192,347	3,791,459
Production of all kinds of rails	3,375,929	3,977,887
Production of all rolled iron and steel, including rails	16,840,015	19,588,468
Production of iron and steel cut nails, in kegs	1,357,549	1,189,239
Production of iron and steel wire nails, in kegs	10,854,892	11,486,647
Imports of iron ore	845,651	1,050,390
Exports of iron ore	208,017	265,240
Imports of iron and steel, foreign value	$26,401,283	$34,827,132
Exports of iron and steel, home value	$142,930,513	$172,555,588
Tonnage of steel vessels built in the calendar year	248,710	336,500
Miles of new railroad built in the calendar year	5,050	5,517

AMONG THE INDUSTRIES OF INDIANA.

(Special Correspondence.)

Indianapolis, Ind. Jan. 6.—The Terre Haute Shaft Coupling & Novelty Co. has been organized and incorporated at Terre Haute with a capital stock of $40,000. Directors are T. J. Martin, C. H. Brown, R. R. Slosser, J. M. Armstrong and N. M. Ely.

Machinery for extracting metals from ores will be manufactured by the Refractory Ore Mfg. Co., which has just been organized and incorporated at Fort Wayne. The company has $100,000 capital, held principally by John H. Bass, William Geake, L. A. Cutlivre, H. J. Horstmann, and Gaylord M. Leslie.

The Central Machine Shops has erected a new shop and equipped it with modern machinery. It is especially equipped for reboring cylinders, facing valve seats and reboring pin holes.

Financial conditions have resulted in thousands of foreign laborers leaving Indiana for their homes in other countries. They seemed unable to understand the situation and have been leaving in large numbers from all parts of the state. The result of this wholesale exodus remains to be seen after the plants that have used their services have been reopened.

Concrete foundations for the new plant of the Scott Stove & Radiator Co. have been completed at Cambridge City, where the company will move from Marion. Construction on the new plant will be rushed from now on.

LARGE VALUATION

Of Iron Products Turned Out by Milwaukee in 1906.

(Special Correspondence.)

Milwaukee, Wis., Jan. 6.—The year's record for Milwaukee in iron products is a good one, compared to preceding years. The total value of the iron, steel and machinery product for the 12 months ending with December was $49,750,000, an increase of about 10 per cent. The wages paid amounted to $7,980,000, and the number of employes was 10,300. The value of farm implements and machinery produced for the year was $7,500,000; electric and telephone supplies, $7,192,000; malleable iron and hardware, $6,390,000; stoves and heating appliances, $4,685,000; structural iron, $4,400,000; wire goods, $705,000.

President W. H. Whiteside, of the Allis-Chalmers Co., is among those who look for a speedy return to sound conditions. "The number and character of inquiries which our offices, located in the principal commercial centers of the country, have recently been receiving, convincingly demonstrate a return of confidence," he says, "and bear evidence that not only a diversified but a large volume of business will be offering ere the middle of the first quarter of 1908 has passed." Others speak in an equally optimistic tone.

The Thomas Furnace Co. has closed down its plant for repairs, which will not be finished until March 1.

The Milwaukee shops of the Milwaukee road built 5,175 cars in the year just closed, and 64 locomotives.

The Milwaukee Refrigerator Co. interests have organized the Milwaukee Car Mfg. Co. for the operation of a new plant north of the city. Four to five cars a day will be turned out here, to begin with.

New Owners in Charge.—The formal transfer of the Northwestern Iron Co. to Ferdinand Schlesinger has taken place at Milwaukee. The new owner succeeded Capt. I. M. Bean as president, the other officers elected being E. N. Dickson, vice-president; Henry J. Schlesinger, second vice-president; Armin A. Schlesinger, treasurer; Jerome Havlisch, secretary; W. K. Packman, general manager. Ferdinand Schlesinger, E. N. Dickson, W. L. Brown and C. P. Wheeler of Pickands, Brown & Co., Chicago, and Henry J. and Armin Schlesinger are the directors. The headquarters will remain in Milwaukee. A silver loving cup standing over 12 inches high was presented to Capt. Bean by employes of the company upon his retirement.

Hopeful Start of New Year in Stocks

With the old year and its trials and troubles ended, the stock market has entered upon a new 12-month period under more favorable indications of improvement than have ruled for weeks. Satisfaction of year-end settlements and disbursements having been made without much additional impairment of the financial situation, increasing confidence is gradually supplanting the apprehension extant previous to this turn of the market and the general state of securities has reflected a stronger feeling of certainty over the future. With this development has come the disappearance of the premium on currency and the resumption generally of cash payments by banks. Call money eased off during the week with a maximum of 20 per cent, corresponding to a rate of 100 per cent or more the same period in the previous years. Another significant incident of the new order of things has been the reduction by the Bank of England in its discount rate from 7 to 6 per cent. Securities as a rule have gained from the favorable effect, quotations in the week showing considerable firmness and an upward tendency. The present position of prices cannot indicate as yet, it is believed, what are the public's intentions as to investment buying, and the present month is expected to cast considerable light upon this question. At the same time it is not generally believed that there will be any large resumption of speculative vigor at an early date. The New York associated bank statement of the week was very encouraging. A large decrease in loans appeared, representing partly liquidation and partly payment of advances made to banking institutions during the depression. There has now been a decrease in loans in every week since Nov. 30 aggregating over $65,000,000. In the past week the net reserve was increased $8,660,800, due to a gain of $8,045,900 in the bank's total cash reserve and a redution in deposits which cut the reserve requirements by $614,900. Against a withdrawal of $2,459,600 from deposits during the week, loans were contracted $14,822,600, making the total loans now about $84,000,000 in excess of deposits. The present reserve shows a deficit of $11,509,550 under the required figures, against a surplus of $147,825 Jan. 5, 1907.

Recent dividend declarations include the following: Allegheny Bridge Co., semi-annual dividend of $2 a share, payable immediately; American Ship Building Co., regular quarterly dividend of 1¾ per cent on its preferred stock, the payment date to be fixed later; American Screw Co., quarterly dividend of 1¾ per cent, payment Dec. 31; Nicholson File Co., quarterly dividend of 2 per cent, payable Dec. 31; American Rolling Mill Co., regular quarterly dividend of 1½ per cent on its preferred stock, payable Jan. 15; Rhode Island Perkins Horse Shoe Co., quarterly dividend of 1¼ per cent on its preferred stock, payable Jan. 15; Montreal Steel Works, semi-annual dividend of 3½ per cent on the common stock; Cutting Car Co., regular quarterly dividend of ½ per cent, payable Jan. 1; Georges Creek Coal & Iron Co., semi-annual dividend of $2.50 per share, payable Jan. 22.

Receivers of the National Steel & Wire Corporation, New Haven, Conn., have announced a dividend of 10 per cent to the stockholders. According to the recent appraisal made, property amounting to $270,000 available for dividends has been found.

The Iroquois Iron Co., Chicago, closed a busy and prosperous year with the payment of its usual dividend in the week of Dec. 22.

THE LEADING INDUSTRIAL SECURITIES.

	Clos'ng Quo Jan. 4	Changes in Week	Date 1907 Ann. M t'g	Stock Outstanding	Dividend Basis	Dividend Last Declared	Dividend Date Last Div. Pay.
Allis-Chalmers	6	+ ½	Sept. 6	19,820,000		.....	.....
Allis-Chalmers pr	17	.....		16,150,000	7 cum	1¾ Q.	Feb., 1904
American Can	4⅝	+ ⅛	Feb. 1	41,233,300		.....	.....
Am. Can pr	47⅝	+ 6		41,233,300	7 cum	1¾ Q.	Oct., 1907
Am. Car and Fdy	31½	+ ½	June 28	30,000,000	1 Q.		Oct., 1907
Am. Car and Fdy pr	89⅞	+6⅜		30,000,000	7 n. c.	1¾ Q.	Oct., 1907
American Loc.	36¾	+2¼	Oct. 16	25,000,000	5	1¼ Q.	Nov. 1907
American Loc. pr	86	− ½		25,000,000	7 cum	1¾ Q.	Oct., 1907
American Ship	44⅛	.....	Oct. 10	7,600,000	4	1	Dec., 1907
American Ship pr	91¼	+6¼		7,900,000	7 n. c.	1¾ Q.	Oct., 1907
Am. Steel Foundries	6½	+ ⅜	Oct. 2	15,810,000		.....	.....
Am. Steel Foundries pr.	29	+ ⅛		17,240,000	6 cum	2½	Aug., 1904
Barney & Smith	65	.....	June 5	2,000,000	4	1 Q.	Sept., 1907
Barney & Smith pr.	128½	.....		2,500 000	8 cum	2 Q.	Sept., 1907
Bethlehem Steel	10½	+2	April 3	14,862,000		.....	.....
Bethlehem Steel pr.	23	.....		14,908,000	7 n. c.	¾ Q.	Feb., 1907
Cambria Steel	27⅝	+ ⅛	March 20	45,000,000*	6	1½ S. A.	Aug., 1907
Cambria Iron	44	+1		8,468,000*	4	2 S. A.	Apr., 1907
Chicago Pneumatic Tool	22	.....	Feb. 19	6,145,800	4	1 Q.	Oct., 1907
Colorado Fuel	20	+1	Oct. 22	34,235,500		3½	Apr., 1903
Crucible Steel	6	.....	Oct. 17	24,578,400		.....	.....
Crucible Steel pr.	55⅜	.....		24,436,500	7 cum	1¾ Q.	Oct., 1907
Empire Steel	5	.....	Feb. 28	2,281,400		.....	.....
Empire Steel pr	52	.....		2,500,000	6 cum	3 S. A.	July, 1906
Fay & Egan	100	.....	Feb. 20	1,000,000	6	1½ Q.	July, 1907
Fay & Egan pr	128½	.....		1,000,000	7 cum	1¾ Q.	Aug., 1907
General Electric	115½	+3½	May 15	65,167,400	8	2 Q.	Oct., 1907
Harbison-Walker	14½	.....	Jan. 22	18,000,000		½	Oct., 1907
Harbison-Walker pr.	69½	.....		9,600,000	6 cum	1½ Q.	Oct., 1907
International Pump	14½	+1	June 5	17,787,300		1	Apr., 1905
International Pump pr.	65¾	+ ⅛		13,835,000	6 cum	1½ Q.	Nov., 1907
Lackawanna Steel.	24	.....	March 14	34,971,400		.....	.....
Lake Sup. Corp.	3¼	.....	Oct. 3	40,000,000		.....	.....
New York Air Brake	55	+3½	June 21	10,000,000	8	2 Q.	Oct., 1907
Niles-Bement-Pond	130	.....	Feb. 7	5,000,000	6	1½ Q.	Dec., 1907
Niles-Bement-Pond pr.	105	.....		2,000,000	6 cum	1½ Q.	Aug., 1907
Otis Elevator Co.	20	.....	March 19	6,375,500		1½ S. A.	Oct., 1907
Otis Elevator Co. pr.	65	−3		6,449,500	6 n. c.	1½ Q.	Oct., 1907
Penn. Steel	57	.....	May 14	10,750,000		.....	.....
Penn. Steel pr	82	.....		16,500,000	7 n. c.	3½ S. A.	Nov., 1907
Pittsburg Coal Co	8¼	+ ¼	Feb. 10	28,297,600		.....	Nov., 1906
Pittsburg Coal pr.	42½	− ¼		27,246,800	7 c.	3½	Apr., 1905
Pressed Stl. Car	20¼	+1¾	Feb. 21	12,500,000		3	Aug., 1904
Pressed Stl. Car pr.	70	+3		12,500,000	7 n. c.	1¾ Q.	Nov., 1907
Pullman	147	+1	Nov. 14	100,000,000	8	2 Q.	Nov., 1907
Railway Stl. Spring	28	+2	March 1	13,500,000	4	2 S. A.	Oct., 1907
Railway Stl. Spring pr.	77	.....		13,500,000	7 cum	1¾ Q.	Dec., 1907
Rep. Iron & Steel	16	− ¼	Oct. 17	27,191,000		.....	.....
Rep. Iron & Steel pr.	67	+1		20,416,900	7 cum	1¾ Q.	Oct., 1907
Sloss-Sheffield	37⅛	+2½	March 6	10,000,000	5	1¼ Q.	Dec., 1907
Sloss-Sheffield pr.	80	.....		6,700,000	7 n. c.	1¾ Q.	Oct., 1907
U. S. Pipe & Fdy.	20⅜	+ ⅜	June 27	12,500,000	4	1 Q.	Dec., 1907
U. S. Pipe & Fdy. pr.	57⅛	+1⅛		12,500,000	7 n. c.	1¾ Q.	Dec., 1907
U. S. Steel	26⅜	.....	April 16	508,302,500	2 n. c.	¼ Q.	Dec., 1907
U. S. Steel pr.	89⅛	+1⅝		360,281,100	7 cum	1¾ Q.	Nov., 1907
U. S. Steel 5's	86⅝	+1⅛		463,798 000	5	5 A.	.....
Va. Iron, Coal & Coke	38	.....	Sept. 18	8,641,600		.....	.....
Westinghouse Elec.	41	−1	June 27	24 998,700*	10	2½ Q.	Oct., 1907
Westinghouse Air Brake	133	.....	Oct. 2	11,000,000*		5 Q.	Oct., 1907

Par value of shares, $100, except those starred (*), $50.

Copper Stocks.

Boston.—Butte Coalition, closed 16⅛; Calumet & Arizona, closed 105; Calumet & Hecla Minin,g closed 600; Green Cananea, closed 7⅛; North Butte Mining, closed 45½; Osceola Mining, closed 85; Quincy Mining, closed 81.

New York.—Amalgamated Copper, closed 49.

NEWS FROM MANY INDUSTRIES

New Buyers.—

Clinton E. Long, Fred R. Long and R. F. Cooley have organized the American Forged Nut Co., Bloomsburg, Pa.

The Hancock-Holmes Foundry & Mfg. Co., Atlanta, Ga., has been organized by A. A. Holmes and others with a capitalization of $25,000.

Fred Pabst, Robert Nunnemacher, and T. F. Howe have organized the Milwaukee Car Mfg. Co., Milwaukee, Wis., with a capital of $50.000.

James Nolin, Morgan Cragin and Charles H. Soelke have taken out a charter for the Cragin-Nolin Boiler Co., 94 La Salle street, Chicago, to manufacture boilers and machinery.

The Powers-Maxwell Foundry Co., Negley, O., has been chartered by E. W. Powers, S. E. Maxwell, E. I. Moore, F. A. Bricker and R. P. Grist with a capital of $10,000

The New Process Steel Wire Mfg. Co., Lancaster, Pa., has been chartered to make all kinds of small steel wire by W. A. Sherwood, J. D. Burkholder and F. R. Ingersoll.

The Wilson Laundry Machinery Co., Columbia, Pa., has been formed by W. B. Given and H. W. Daren, Chicago, and F. S. Given, H. W. Zeamer and H. W. Bender, Columbia.

The Davis Steam Generator & Mfg. Co., Sidney, O., has been incorporated with a capital of $25,000 by Samuel S. Davis, Walker C. Morrison, A. W. Wells, E. S. Hoskins and Frank Lucas.

The Reliance Concrete Mixer Co., 226 La Salle street, Chicago, to manufacture concrete mixing machinery, has been formed with a capital of $20,000 by John G. Campbell, Gorgon L. Gray and Roy H. Hunter.

Articles of incorporation have been filed by the Straubel Machine Co., Green Bay, Wis., with a capital of $25,000. Those interested are: Edward L. Straubel, Ernest T. Straubel and L. A. Straubel.

William Durst, Brooklyn, has been incorporated to manufacture brass goods, railings and hardware by William Durst, William F. Durst and George H. Durst, No. 397A Hancock street, Brooklyn. The capitalization is $25,000.

The Monighan Machine Co., Security building, Chicago, has been organized by C. T. B. Goodspeed, James M. Proudfit and T. Frank Laramie with a capital stock of $100,000 to manufacture machinery and metal work.

The R. H. Long Machinery Co., machinery, Framingham, Mass., has been incorporated with a capital of $200,000 and the officers are as follows: President, Charles F. Pooler; treasurer, Richard H. Long; clerk, George G. Whittemore; all of Framingham.

The Young Marine Mfg. Co., Buffalo, with a capital of $10,000 has been organized for foundry and machine shop work by Lucius W. Young, Tonawanda, N. Y., John F. Kinney, William J. Kinney, 150 O'Connell avenue, Buffalo.

The Standard Machine Co., Columbus, O., has been chartered by R. J. Odell, J. C. Burns, R. M. Lucas, C. E. Blanchard and M. I. Reed to do a general manufacturing business. The company is capitalized at $10.000.

The Keystone Steel Foundry Co. has been chartered to operate at Avonmore, Westmoreland county, Pa. It has a capital of $150,000, $75,000 of which is held by Joseph H. Sauers, whose foundry was placed in the company.

The New England Trolley Wheel Co., Chicopee, Mass., has filed articles of incorporation with a capital of $50,000. The officers of the company are: President, Louis J. Tetlow; treasurer and clerk, Michael I. Shea, both of Chicopee Falls.

The Fuller Mfg. Co., Danvers, Mass., tools, has been organized with a capitalization of $15,000. The officers of the company are: President and treasurer, Arthur E. Fuller; clerk, William E. Clapp, both of the address given above.

Articles of incorporation have been filed by the Gonder & Birch Co., Elm Grove, W. Va., to operate a foundry and machine shop. The capital stock of the company is $10,000, and the incorporators are: William Birch, William Gonder and George Leinweber.

With an authorized capital of $100,000, the Safety Car Coupler Co., Chattanooga, Tenn., has been organized to manufacture a safety car coupler patented by D. J. Sauls. Those interested are: A. W. Boyd, John Shamotulski, M. A. Brown and others.

The Electric Mfg. Co., New Orleans, La., capital $25,000, has been chartered by George W. Logan, Warren B. Reed and Edward S. D. Logan. The company will manufacture and deal in electrical, mechanical, compressed air and gas appliances, tools, machines and other equipment.

The Edgar Mfg. Co., 310-16 West Twentieth street, Kansas City, has been incorporated with a capital of $20,000 to manufacture refrigerating and ice-making machinery. The officers of the company are: President, E. B. Nettleton; vice president and general manager, Charles E. Edgar; secretary-treasurer, F. E. Nettleton.

The New York Sheet Metal Works, New York, has been organized to manufacture ornamental sheet metal work. The capital stock of the company is $15,000, and the incorporators are: Adolph Krause, Sarah Krause, 215 West 140th street; Nathan Coleman, 355 West 115th street, all of New York.

The Spring Valley Iron Co. has been incorporated to mine for ore in Dickinson, Iron, Marquette, Gogebic and Menominee counties in Michigan. The principal offices will be at Wellston, O., and the parties interested are: Porter McMillen, Detroit; E. P. Willis, Jerry Morrow, J. M. McGhee and J. K. Clutes. The company controls the Zimmerman exploration in the Spring valley district near Stambaugh in the Menominee range.

Articles of incorporation have been filed by the John Redman Co., Fishkill Landing, N. Y., with a capital of $10,000 to manufacture plumbing, heating, lighting and building material and supplies. Those interested are: Rhoda Redman Eyre and Manning K. Eyre, 290 Ridgewood avenue, Glenridge, N. Y., and Alice Horrocks, Fishkill Landing, N. Y.

New Construction:—

The Oil Well Supply Co., Pittsburg, advises that it is erecting a store and warehouse in Los Angeles, Cal., for the distribution of its goods in that district, but does not anticipate the construction of a manufacturing plant, as had been reported.

The Adamson Machine Co., Akron, O., is the incorporation of the foundry, machine and pattern business of A. Adamson. At the present time, the incorporation does not contemplate any general changes in the business but later a larger and commodious plant will be erected. The principal line of production of the company will continue to be rubber-working machinery.

Charles H. Allmond & Co., Seattle, Wash., are rebuilding their plant as it was before the recent fire. The main building will be 50 x 102 feet, of which 40 x 50 feet will be two stories high. The lower floor of the latter part will be used as a cleaning room and the upper floor as a store room for patterns. This leaves the foundry floor 50 x 62 feet. At present the company is not in the market for much new equipment. Its work has

been principally specialties, for which it builds its own machines.

The machine shop department of the business of the Brown Bros. Mfg. Co., Nappanee, Ind., has been taken over by J. W. Rosbrugh, who will operate it under the title of the Nappanee Iron Works. It is the intention of Mr. Rosbrugh to add a foundry 60 x 80 feet, and to increase the present size of the machine shop for the purpose of manufacturing and repairing general machinery. For the present no additional machinery will be required. The firm is soliciting inquiries for portable cylinder boring bars, combination punch and shears and hydraulic lard and tallow presses.

The James A. Brady Foundry Co., Thirty-fifth street and Ashland avenue, Chicago, manufacturer of high grade machinery castings, advises that the recent lease on additional land taken by it now gives it ground space of 120 x 600 feet at that location. The new shop erected by the company is 90 x 250 feet, with a 30 x 75 foot pattern and office room addition. The plant costs approximately $50,000 and is thoroughly up-to-date in all its arrangements and equipment. The land, referred to by THE IRON TRADE REVIEW recently, as having been leased by the company, is merely for additional yard room.

General Industrial Notes: —

Earl H. Turner has been named as receiver of the Nutting Machine Co., Dayton, O., upon the application of Frank T. T. Huffman, a creditor. It is declared that the company's assets exceed its liabilities.

The Advance Stamping & Mfg. Co., Indianapolis, recently organized, succeeds the Advance Machinery & Supply Co. The capacity of the plant has been doubled and new capital has been interested to conduct the business on a much larger scale than heretofore.

The Standard Steel Car Co., Pittsburg, reports that the recent increase in the capital stock of its company was not made for additions or improvements to its plant, but is to carry out financial arrangements made several years ago.

The Gurney Refrigerator Co., Fon du Lac, Wis., has begun the manufacture of a square steel refrigerator. As has always been the policy of the company in its operations, no expense is being spared to provide the best equipment for the production of its new line.

The Detroit Machinery Co., Detroit, manufacturer of glue room machinery, has been sold to the Monroe Machinery Co. P. J. Smith, the manager, retains his interest. The officers of the Detroit company are: W. A. Whiting, president; G. W. Willebrand, secretary and treasurer, and P. J. Smith, manager.

The Hann Mfg. Co., Columbus, O., which manufactures a patent mail box, has increased its capital stock from $10,000 to $25,000. The officers of the company are: C. K. Hann, president; J. E. Dager, vice president, and A. M. Hann, secretary.

Notices have been sent out announcing the annual meeting Jan. 28 of the stockholders of the Buckeye Steel Castings Co., Columbus, O. There will be no change in the directory or in the officers of the company. The annual report of the president will show that 1907 has been a prosperous year.

Among recent increases of capital of Pennsylvania corporations are the following: The Westinghouse Air Brake Co., from $11,000,000 to $14,000,000; North American Smelting Co., Philadelphia, from $5,000 to $200,000; Philadelphia Roll & Machinery Co., Philadelphia, from $200,000 to $400,000; Pennsylvania Steel Pulley Co., Pittsburg, from $5,000 to $500,000; Fayette R. Plumb, Inc., Philadelphia, from $350,000 to $700,000.

The stockholders of the Northern Connellsville Coke Co., Connellsville, Pa., have elected the following directors: Wade H. Eckard, George W. Campbell, Daniel Hunt, James W. Buttermore, J. M. Doyle, John M. Muman, Thompson Hunt and C. H. Eckard. The directors chose the following officers: Wade H. Eckard, president; Daniel Hunt, vice president; George W. Campbell, secretary, and James W. Buttermore, treasurer.

At the annual meeting of the Chase Foundry & Mfg. Co., Columbus, O., all of the members of the board of directors were re-elected. The directory met and re-elected the old officers, as follows: President, P. A. Myers; vice president, Guy C. Myers; general manager, S. M. Chase; superintendent, W. C. Stocklin, and secretary-treasurer, Edward Kaemmerer. The president's report showed that the company had the best business in its history during 1907.

The business heretofore conducted by W. E. Shipley, Philadelphia, under his own name, has been incorporated under the name of the W. E. Shipley Machinery Co. George A. Bauer, W. S. Hagaman and J. L. Stewart, who have been connected with the business for several years, are associated with Mr. Shipley in the incorporation.

The Albany Foundry Co., Albany, N. Y., manufacturer of heating and cooking appliances, is not contemplating immediate erection of any new buildings as the result of its recent increase of capital. The enlargement of its working fund was made to meet the needs of a rapidly growing trade and to permit the entry of new parties into the business.

The Detroit Trust Co., receiver for E. Bement's Sons, Lansing, Mich., manufacturers of farming implements, has announced a second dividend of 10 per cent to creditors. The total amount paid to creditors, secured, unsecured and preferred to date is $302,553.02, representing about 48 per cent of the total indebtedness.

The Falls Rivet & Machine Co., Cuyahoga Falls, O., has been granted a 50-year franchise by the council of that city to use the water power from the Cuyahoga river for power and heating purposes. The surplus of electric power over the needs of the company will probably be placed at the service of the people of Akron and Cuyahoga Falls.

Upon the application of counsel representing Arthur Falkandu and Francis H. Stillman, of Brooklyn, minority stockholders, a receiver has been named for the Reliance Steel Foundry Co., of Delaware, N. J. The company was incorporated last May, and its liabilities and assets are said to about balance. Part of the assets is a new plant recently built at Delaware.

The plant of the Westerville Foundry & Machine Co., Westerville, O., has been sold at receivership sale to J. W. Hance and his son, Harry Hance. Mr. Hance and son formerly operated the Hance foundry in Columbus. For some time they have been operating a foundry at Plain City, O. The business of the Plain City plant will be taken to Westerville and combined with that of the Westerville plant. A number of improvements are planned for the Westerville plant.

The E. H. Mumford Co. has acquired by purchase all the patent rights, molding machines and equipment of Ph. Bonvillain & E. Ronceray in the United States, and has added to its molding machine line these machines and pattern processes. The offices of the E. H. Mumford Co. will be removed from Seventeenth and Callowhill streets to 1315 Race street, Philadelphia, where the French machines have been installed for some months as a working exhibit.

The Stratford Mfg. Co., Ltd., Stratford, Canada, will manufacture hay slings, hay carriers, Boyer's gliding settees, yard swings, ladders, etc. The

line will duplicate that manufactured by the Goshen Mfg. Co., Goshen, Ind., of which Allen P. Boyer, who is to be the president of the Stratford Mfg. Co., is president. The company has its buildings completed and nearly all its equipment on the ground. It is expected to begin operations in January.

At a meeting of the board of directors of the Big Four Implement Co., Kansas City, Col. W. B. Brinton, president of the Grand Detour Plow Co., Dixon, Ill., was elected president, vice H. C. Staver, deceased; F. H. McAdow, secretary of the Staver Carriage Co., Chicago, was chosen vice president, succeeding R. R. Frey, who had resigned because of press of other duties; W. S. Thomas, of the Thomas Mfg. Co., Springfield, was made treasurer, and H. G. Moore, of Kansas City, secretary and manager.

Charles B. Leonard and Harry B. Russell, formerly with the Randall Tramrail Co., are operating the Philadelphia Tramrail Co., with a factory at Front and Tusculum streets, and an office at 1009 Drexel building, Philadelphia. Mr. Leonard has had about 20 years' experience in manufacturing tramrail systems, and Mr. Russell, who has had about 15 years' experience in the manufacturing end of this work, is looking after this part of the business for the Philadelphia Tramrail Co. C. H. Fries, formerly with the Moyer Tramrail Co., who has had five years' experience in structural designing, and three years' experience with the overhead tramrail systems, is now acting as agent for the Philadelphia company.

Mossman, Yarnelle & Co., Fort Wayne, Ind., wholesale merchants in iron, hardware, etc., have taken up their quarters in their handsome new building which has just been completed at a great expense. The new building is 122 x 150 feet, four stories, above a 12-foot basement and is completely equipped throughout with all modern facilities, including freight and passenger elevators for the operation of a large business. The new building is typical of the present position of the company in the business world, its rise from a year's total volume of $65,000 to $1,250,000 having been made in a comparatively short period. The house was founded in 1882 by E. F. Yarnelle and the late Frank Alderman under the firm name of Alderman & Yarnelle. In 1890 the firm became Mossman, Yarnelle & Co., and the partners are: W. E. Mossman, E. F. Yarnelle, B. Paul Mossman and E. R. Yarnelle.

Trade Notes:—

The new address of the Tennessee Coal, Iron & Railroad Co., New York, since Jan. 1 has been Empire building, 71 Broadway.

Body, Baird & Co., Philadelphia, iron and steel, have removed from offices in the Pennsylvania building to the Drexel building.

The district office of the Carnegie Steel Co., at Atlanta, Ga., was moved to Birmingham, Ala., Jan. 1, where headquarters are in the Woodward building.

The Northern Engineering Works, Detroit, Mich., has installed a 42-inch Newten cupola in the foundry of the Seattle Car & Mfg. Co., Youngstown, Wash.

The L. H. Goodnow Foundry Co., Fitchburg, Mass., has made additions to equipment and installed a Newten cupola with an hourly capacity of 8 to 9 tons.

The West End Tube Works, McKees Rocks, Pa., announces that with its greatly increased facilities, additional equipment and arrangement it is in position to promptly care for orders.

The Wile Power Gas Co. has removed its general offices from the Cutler building, Rochester, N. Y., to 1688 to 1692 Columbus road, Cleveland, O., where all communications in the future for gas power plants, including gas engines and gas producers for gas power and fuel purposes, should be addressed.

Fires:—

Richter & Co., brass founders, Cincinnati, sustained a loss of about $50,000 by fire Dec. 24.

Fire in the engine room of the plant of the L. Schreiber Sons Co., Cincinnati, foundryman, caused damage of several thousand dollars Dec. 20.

The electric light plant of the Edgar Thomson works of the Carnegie Steel Co., Braddock, Pa., suffered a loss of about $10,000 from fire which followed an explosion Jan. 3.

Upon the petition of the Badger Brass Mfg. Co., Kenosha, Wis., Judge Belden, of Racine, Wis., has enjoined the members of seven locals of the Metal Polishers', Buffers', Platers', Brass Molders', Brass and Silver Workers' Union of North America from congregating about the company's plant, from hindering, assaulting or coercing employes, from picketing the premises or in any way interfering with the conduct of the company's business. The petition charges the defendants with conspiracy to cripple and destroy the business of the company.

TRADE PUBLICATIONS.

JACKS.—The Chicago Steel Foundry Co., Chicago, is issuing a small catalog containing descriptions and illustrations of its three-piece auto jacks, automobile jacks, wagon jacks, stake pullers, traction jacks, railroad jacks, heavy machinery jacks, telephone pole pullers, etc., with capacities, weights, dimensions and retail prices of each type.

RIVETING MACHINES.—John F. Allen, 370-372 Gerard avenue, New York city. A 31-page catalog dealing with portable pneumatic percussion and compression riveting machines for structural bridge and railroad work, boiler, tank and stack construction. Tables showing standard dimensions and numerous testimonials are given. Some of these riveting machines include Allen's jaw riveters, compression lever riveters, portable pneumatic hammer boiler riveters, alligator riveters, taper boiler riveters, etc.

INDUSTRIAL AND MINE CARS.—The Kilgore-Peteler Co., Minneapolis, Minn. Catalog. 56 pages. 6 x 9 inches. The cars shown in the pages of this catalog are standard cars for handling every class of material on narrow-gage railways for mines, shops, saw mills, power plants, docks, warehouses, etc. The other articles manufactured by the above company which are described and illustrated include Peteler wheels, journal boxes, axles, castings, structural work, etc. The various types of cars include standard rotary mine cars, concrete cars, rotary dump cars, push cars, contractors' two-way dump cars, charging cars, transfer cars, core oven cars, lumber cars and many other types.

MACHINE TOOLS.—The Newton Machine Tool Works, Inc., Philadelphia. Catalog No. 45. 6 x 9 inches. A very complete catalog, superior to any previously issued by this company, containing 303 numerously illustrated pages bound in buckram, dealing generally with the subject of machine tools and calling attention to the fact that many of the machines illustrated are being re-designed and the entire line improved. Illustrations, descriptions and dimensions of all the various lines of tools are given, some of which include milling machines, boring machines, planing machines, shaping machines, slotting machines and miscellaneous tools.

COVERING.—The Philip Carey Co., Cincinnati, O. Catalog. 70 pages. 6 x 9 inches. An unusually handsome catalog bound in heavy tan paper with the title "Carey's Coverings" embossed in white letters, pointing out the advantages of the coverings manufactured by this company. They are fireproof and nonconductors of heat, are cheap, and prevent the loss of heat through radiation. Removable covers for fittings, including globe valves, crosses, etc., are furnished in sectional form. A price list applying to high and low pressure sectional steam pipe coverings is given and some of the various forms of coverings include Carey's magnet covering, standard asbestos molded covering, argentum covering, furnace pipe covering, etc.

EXHAUST STEAM.—The Harrison Safety Boiler Works, Philadelphia, is sending out a mail folder on "The Utilization of Exhaust Steam in Wood Working Establishments." With the exception of what is said about the use of exhaust steam in dry kilns and for steaming lumber, the points brought out apply to most steam plants, covering the use of the Cochrane open feed-water heaters and the hot process system of water purification for keeping scale out of boilers, increasing the capacity of the boilers and saving coal and boiler feed water. The folder shows an interesting layout for engine, heater, drying and heating coils and connections.